SCIENCE

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CONTENTS:

The Beginnings of American Astronomy: EDWARD S. HOLDEN.....929
Inheritance of Acquired Characteristics: JOHN M. MACFARLANE.....935
Current Notes on Physiography:—Uplands and Valleys of Kansas; Bell on Canadian Rivers; The Plateau of West Virginia; Crater Lake and Mt. Mazama, Ore.: W. M. DAVIS.....945
Current Notes on Anthropology:—Man and His Environment; Slavery of the American Indians: D. G. BRINTON.....947
Notes on Inorganic Chemistry: J. L. H.....948
Scientific Notes and News.....950
University and Educational News.....9...54
Discussion and Correspondence:—The Distribution of Marine Mammals: THEO. GILL, G. BAUR, ARNOLD E. ORTMANN. *The Potter's Wheel in America:* D. G. BRINTON.....955
Scientific Literature:—Cambridge Natural History, Vol. II.: W. MCM. WOODWORTH. *Wilson on the Swastika; de Mortillet's L'Origine de la Nation Française:* D. G. BRINTON.....958
Scientific Journals:—The American Chemical Journal: J. ELLIOTT GILPIN.....961
Societies and Academies:—The Biological Society of Washington: F. A. LUCAS. *Boston Society of Natural History:* SAMUEL HENSHAW.....963
New Books.....964

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THE BEGINNINGS OF AMERICAN ASTRONOMY.

IT is impossible, even in the briefest sketch, not to emphasize the debt of American science and learning to the intelligent interest and patronage of our early Presidents—Washington, John Adams, Jefferson, Madison, Monroe, John Quincy Adams. The powerful impetus given by them and through them has shaped the liberal policy of our governments, National and State, towards education and towards science. Sir Lyon Playfair, in his address to the British Association for the Advancement of Science (1885), has recognized this influence in the truest and most graceful way. He said: "In the United Kingdom we are just beginning to understand the wisdom of Washington's Farewell Address to his Countrymen (1796) when he said: 'Promote, as an object of primary importance, institutions for the increase and diffusion of knowledge; in proportion as the structure of a government gives force to public opinion, it is essential that public opinion should be enlightened.'"

Until the Revolution (1776) American science was but English science transplanted, and it looked to the Royal Society of London as its censor and patron. Winthrop, Franklin and Rittenhouse were, more or less, English astronomers. Franklin was the sturdiest American of the three. As early as 1743 he suggested the formation of the American Philosophical Society of Philadelphia. John Adams founded the American Academy of Arts and Sciences in Boston in 1780. These two societies, together with Harvard College (founded in

1636), Yale College (1701), the University of Virginia (founded by Jefferson in 1825) and the United States Military Academy at West Point (1801), were the chief foci from which the light of learning spread. Other colleges were formed or forming all over the Eastern and Middle States during the early years of the century.

The leading school of pure science was the Military Academy at West Point, and it continued to hold this place until the Civil War of 1861. From its corps of professors and students it gave two chiefs to the U. S. Coast Survey; and the army, particularly the corps of engineers, provided many observers to that scientific establishment, besides furnishing a large number of professors and teachers of science to the colleges of the country. The observatory of the Academy was founded by Bartlett, in 1841, and much work was done there, only a small part of which is published. The Coast Survey was a school of practice for army officers, and their experience was utilized in numerous boundary-surveys during the period 1830–50. Colonel J. D. Graham, for example, was Astronomer of the survey of the boundary between Texas and the United States in 1839–40; Commissioner of the Northeast boundary survey 1840–43; Astronomer of the Northwest boundary survey 1843–47; of the boundary between the United States and Canada 1848–50; of the survey of the boundary between Pennsylvania and Virginia 1849–50; of the boundary survey between Mexico and the United States 1850–51. The names of Bonneville, Talcott, Cram, Emory and other army officers are familiar in this connection, and their work was generally of a high order. It was in such service that Talcott invented or reinvented the Zenith Telescope, now universally employed for all delicate determinations of latitude. The mechanical tact of Americans has served astronomy well. The sextant was invented by Thomas Godfray, of Philadelphia, in 1730, a year before Hadley brought forward his proposal for such an instrument.* The chronograph of the Bonds, the Zenith Telescope of Talcott and the break-circuit chronometer Winlock are universally used to-day. The diffraction-gratings of Rutherfurd were the best to be had in the world till they were replaced by those of Rowland. The use of a telescope as a collimator was first proposed by Rittenhouse. The pioneer opticians of the United States were Holcomb (1826), Fitz (1846 or earlier), Clark (1845), Spencer (1851). Only the Clarks have a world-wide reputation. Würdemann, instrument maker to the U. S. Coast Survey (1834) had a decided influence on observers and instrument-makers throughout the United States, as he introduced extreme German methods and models among us, where extreme English methods had previously prevailed. The system of rectangular land surveys which proved to be so convenient for the public lands east of the Rocky Mountains was devised and executed by Mansfield, a graduate of the Military Academy.

The list of army officers who became distinguished in civil life as professors in the colleges of the country is a very long one. Courtenay (class of 1821 at West Point) was professor of mathematics at the University of Pennsylvania, 1834–36, at the University of Virginia, 1842–43, and was the author of admirable text-books. Norton (class of 1831) became professor at New Haven, and wrote a very useful text-book of astronomy in 1839; and the list

* In 1700 Sir Isaac Newton sent drawings and descriptions of a reflecting sextant to Halley for his advice. At Halley's death these were found among his papers. Hadley's device (1731) was undoubtedly derived from Newton's MSS. The Royal Society of London granted £200 to Godfray for his invention which his brother, Captain Godfray, had previously put into practical use in the West Indies.

could be much extended. The excellent training in mathematics at West Point (chiefly in French methods) early made itself felt throughout the whole country. The mathematical text-books of Peirce of Harvard and of Chauvenet of the Naval Academy, brought the latest learning of Europe to American students. Mitchell (class of 1829 at West Point) was the only graduate who became a professional astronomer (1842–61). His direct service to practical observing astronomy is small, but his lectures (1842–48), the conduct of the Cincinnati observatory (1845–59), and his publication of the *Sidereal Messenger* (1846–48), together with his popular books, excited an intense and widespread public interest in the science, and indirectly led to the foundation of many observatories. He was early concerned in the matter of using the electric current for longitude determinations and his apparatus was only displaced because of the superior excellence of the chronograph devised by the Bonds. His work was done under immense disadvantages, in a new community (Ohio), but the endowment of astronomical research in America owes a large debt to his energy and efforts.

The Navy and the U. S. Naval Academy (founded by Bancroft in 1845, at the suggestion of Chauvenet) were very active in astronomical work. Chauvenet (Yale College, 1840) published a text-book of Trigonometry, in 1850, which had an important share in directing attention to rigid, elegant and general methods of research. His astronomy (1863) is a hand-book for all students. Walker, Gilliss, Coffin, Hubbard, Ferguson, Keith, Yarnall, Winlock, Maury, Wilkes, were all connected with the Navy, more or less intimately. Walker's career was especially brilliant; he graduated at Harvard College in 1825, and established the Observatory of the Philadelphia High School in 1840. He was the leading spirit in the U. S. Naval Observatory at Washington (1845–47) and introduced modern methods into its practice at the beginning. From the Observatory he went to the Coast Survey to take charge of its longitude operations, and he continued to direct and expand this department until his death, in 1853. To him, more than to any single person, is due the idea of the telegraphic method ('the American method') of determining differences of Longitude. His assistant in this work was Gould, who succeeded to the charge of it in 1853. His researches extended to the field of mathematical astronomy also, and his theory of the planet *Neptune* (then newly discovered) marks an important step forward. His investigations and those of Peirce were conducted in concert and attracted general and deserved attention.

The exploring expedition of Wilkes required corresponding observations to be made in America, and during the period 1838–42 William Bond, at Dorchester, and Lieutenant Gilliss, at Washington, maintained such a series with infinite assiduity and with success. The results of Gilliss' astronomical expedition to the southern hemisphere (Chile, 1849–52) were most creditable to him and to the navy, though his immediate object—the determination of the solar parallax—was not attained.

The Coast Survey began its work in 1817 under Hassler, a professor from West Point, who impressed upon the establishment a thoroughly scientific direction. Bache, his successor (a grandson of Benjamin Franklin), was a graduate of West Point in the class of 1825, and took charge of the Survey in 1843. He is the true father of the institution, and gave it the practical efficiency and high standard which characterized its work. He called around him the flower of the army and navy, and was ably seconded by the permanent corps of civilian assistants —Walker, Saxton, Gould, Dean, Blunt,

Pourtales, Boutelle, Hilgard, Schott, Goodfellow, Cutts, Davidson and others.

Silliman's (& Dana's) *American Journal of Science* had been founded at New Haven in 1818, and served as a medium of communication among scientific men. A great step forward was made in the establishment of the *Astronomical Journal* by Dr. Gould on his return from Europe at the close of 1849.* *Silliman's Journal* was chiefly concerned with the non-mathematical sciences; though it has always contained valuable papers on mathematics, astronomy and physics, especially from the observers of Yale College—Olmsted, Herrick, Bradley, Norton, Newton, Lyman and others. In Mason, who died in 1840 at the age of 21, the country lost a practical astronomer of the highest promise.† *Gould's Journal* was an organ devoted to a special science. It not only gave a convenient means of prompt publication, but it immediately quickened research and helped to enforce standards already established and to form new ones. The *Astronomical Notices* of Bruennow (1858–62) might have been an exceedingly useful journal with an editor who was willing to give more attention to details, but, in spite of Bruennow's charming personality and great ability, it had comparatively little influence on the progress of the science.

The translation of the *Mécanique Céleste* of Laplace by Nathaniel Bowditch, the supercargo of a Boston ship (1815–17), marks the beginning of an independent mathematical school in America. The first volume of the translation appeared in 1829; at that time there were not more than two or three persons in the country who could read it critically. The works of the great mathematicians and astronomers of France and Germany — Laplace, Lagrange, Legendre, Olbers, Gauss, W. Struve, Bessel—were almost entirely unknown.

Bowditch's translation of the *Mécanique Céleste*, and, still more, his extended commentary, brought this monumental work to the attention of students and within their grasp. His *Practical Navigator** contained the latest and best methods for determining the position of a ship at sea, expressed in simple rules. American navigators had no superiors in the first half of this century. Nantucket whalers covered the Pacific, Salem ships swarmed in the Indies, and the clipper-ships made passages round the Horn to San Francisco, which are a wonder to-day. Part of their success is due to the bold enterprise of their captains (who were said to carry deck-loads of studding-sail booms to replace those carried away!), but an important part depended on their skill as observers with the sextant. One of the sister ships to the one of which Bowditch was supercargo was visited at Genoa by a European astronomer of note (Baron de Zach), who found that the latest methods of working lunar distances to determine the longitude were known to all on board, sailors as well as officers. His bewilderment reached its climax when the navigator called the negro cook from the galley and bade him expound the methods of determining the longitude to the distinguished visitor.

On Bowditch's own ship there was "a crew of twelve men, everyone of whom could take and work a lunar observation as well, for all practical purposes, as Sir Isaac Newton himself." Such crews were only to be found on American ships in the palmy days of democracy. All were cousins or

*The *Astronomische Nachrichten* had been founded in Altona, by Schumacher, in 1821.

†See the *International Review*, Vol. X., p. 585.

*First edition, 1802. Sumner's method in navigation (1843)—a very original and valuable contribution from a Boston sea-captain—and Maury's Wind and Current Charts, begun in 1844, are two other notable contributions from a young country to an art as old as commerce.

neighbors, and each had a 'venture' in the voyage. But these anecdotes may serve as illustrations of the intellectual awakening which came about as soon as our young country was relieved from the pressure of the two wars of 1776 and 1812. An early visitor, Baron Hyde de Neuville (1805), felt 'an unknown something in the air,' 'a new wind blowing.' This new spirit, born of freedom, entered first into practical life, as was but natural; science next felt its impulse, and, last of all, literature was born. Emerson hailed it (in 1837) 'as the sign of an indestructible instinct.' "Perhaps the time is already come," he says, "when the sluggard intellect of this country will look from under its iron lids and fill the postponed expectation of the world with something better than the exertions of mechanical skill. Our day of dependence, our long apprenticeship to the learning of other lands, draws to a close. The millions that around us are rushing into life cannot always be fed with the sere remains of foreign harvests."

Benjamin Peirce, a graduate of Harvard in the class of 1829, had been concerned with the translation of the *Mécanique Céleste*, and was early familiar with the best mathematical thought of Europe. He became professor in Harvard College in 1833, and, after the death of Bowditch in 1838, he was easily the first mathematical astronomer in the country. His instruction was precisely fitted to develop superior intelligences, and this was his prime usefulness. Just such a man was needed at that time. Besides his theoretical researches on the orbits of the planets (specially *Uranus* and *Neptune*) and of the moon, his study of the theory of perturbations, and his works on pure mathematics and mechanics, he concerned himself with questions of practical astronomy, although the observations upon which he depended were the work of others. He was the consulting astronomer of the *American Ephemeris* and *Nautical Almanac* from its foundation in 1849, and its plans were shaped by him to an important degree. His relative, Lieutenant Davis, United States Navy (the translator of Gauss' *Theoria Motus Corporum Cœlestium* (1857)), was placed in charge of the *Ephemeris*, and the members of its staff—Runkle, Ferrel, Wright, Newcomb, Winlock and others—most effectively spread its exact methods by example and precept. Professor Peirce undertook the calculations relating to the Sun, *Mars* and *Uranus* in the early volumes of the *Ephemeris*. As a compliment to her sex, Miss Maria Mitchell was charged with those of *Venus; Mercury* was computed by Winlock, *Jupiter* by Kendall, *Saturn* by Downes, *Neptune* by Sears Walker.

The Smithsonian Institution was founded in 1846, and Joseph Henry was called from Princeton College to direct it. There never was a wiser choice. His term of service (1846–78) was so long that his ideals became firmly fixed within the establishment and were impressed upon his contemporaries and upon a host of younger men. The interests of astronomy were served by the encouragement of original research through subsidies and otherwise, by the purchase of instruments for scientific expeditions, by the free exchange of scientific books between America and Europe, and by the publication of the results of recondite investigations. It is by these and like services that the Institution is known and valued among the wide community of scientific men throughout the world.

But this enumeration of specific benefits does not convey an adequate idea of the immense influence exercised by the Institution upon the scientific ideals of the country. It was of the first importance that the beginnings of independent investigation among Americans should be directed towards right ends and by high and unselfish aims. In the formation of a scien-

tific and, as it were, a moral standard a few names will ever be remembered among us; and no one will stand higher than that of Henry. His wise, broad and generous policy and his high personal ideals were of immense service to his colleagues and to the country.

The establishment of a National Observatory in Washington was proposed by John Quincy Adams in 1825; but it was not until 1844 that the U. S. Naval Observatory was built by Lieut. Gilliss, of the Navy, from plans which he had prepared. By what seems to have been an injustice Gilliss was not appointed to be its first Director.* This place fell to Lieut. M. F. Maury. Gilliss had been on detached service for some years, and a rigid construction of rules required that he should be sent to sea, and not remain to launch the institution which he had built and equipped.

The first corps of observers at Washington (1845) contained men of first-class ability—Walker, Hubbard, Coffin. Gilliss's work as astronomer to Wilkes Exploring Expedition (1838–42) at his little observatory on Capitol Hill, had shown him to be one of the best of observers, as well as one of the most assiduous. His study and experience in planning and building the the Naval Observatory had broadened his mind. To the men just named, with Peirce, Gould and Chauvenet, and to their coadjutors and pupils, we owe the introduction of the methods of Gauss, Bessel and Struve into the United States, and it is for this reason that American astronomy is the child of German, and not of English science.

The most natural evolution might seem to have been for Americans to follow the English practice of Maskelyne and Pond. But the break caused by the War of Independence, by the War of 1812, and by the years necessary for our youthful governments to consolidate (1776–1836) allowed our young men of science to make a perfectly unbiased choice of masters. The elder Bond (William Cranch Bond, born 1789, Director of Harvard College Observatory, 1840–1859) was one of the older school and received *his* impetus from British sources during a visit to England in 1815.

In estimating the place of the elder Bond among scientific men it is necessary to take into account the circumstances which surrounded him. He was born in the first year of the French Revolution (1789); he was absolutely self-taught; practically no astronomical work was done in America before 1838. When Admiral Wilkes was seeking for coadjutors to prosecute observations in the United States during the absence of his exploring expedition he was indeed fortunate in finding two such men as Bond and Gilliss. Their assiduity was beyond praise and it led each of them to important duties. Bond became the founder and Director of the Observatory of Harvard College, while Gilliss is the father of the United States Naval Observatory at Washington, as well as of that of Santiago de Chile, the oldest observatory in South America. Cambridge, though the seat of the most ancient university in America, was but a village in 1839. The College could afford no salary to Bond, but only the distinction of a title, 'Astronomical Observer to the University,' and the occupancy of the Dana house, in which his first observatory was established. His work there, as elsewhere, was well and faithfully done, and it led the College authorities to employ him as the astronomer of the splendid observatory which was opened for work in 1847. At that time the two largest telescopes in the world were those of the Imperial Observatory of Russia (Poulkova) and its com-

*He was, however, Director during the years 1861–65.

panion at Cambridge. Each of these instruments has a long and honorable history. Their work has been very different. Who shall say that one has surpassed the other? We owe to Bond and his son the discovery of an eighth satellite to *Saturn*, of the dusky ring to that planet, the introduction of stellar photography, the invention of the chronograph by which the electric current is employed in the registry of observations, the conduct of several chronometric expeditions between Liverpool and Boston to determine the Transatlantic longitude, and a host of minor discoveries and observations.

Gilliss visited France for study in 1835, before he took up his duties at Washington. The text-books of Bond and Gilliss were the Astronomies of Vince (1797–1808) and of Pearson (1824–29). The younger Bond (George Phillips Bond, born 1825, Harvard College 1844, Director of the Harvard College Observatory 1859–65) and his contemporaries, on the other hand, were firmly grounded in the German methods, then, as now, the most philosophical and thorough.

It was not until 1850, or later, that it was indispensable for an American astronomer to read the German language and to make use of the memoirs of Bessel, Encke and Struve and the text-books of Sawitsch and Brünnow.* This general acquaintance with the German language and methods came nearly a generation later in England. The traditions of Piazzi and Oriani came to America with the Jesuit Fathers of Georgetown College (1844), of whom Secchi and Sestini are the best known.

The dates of the foundation of a few observatories of the United States may be set down here. Those utilized for the observation of the transit of Venus in 1769 were temporary stations merely. The first college observatory was that of Chapel Hill, North Carolina (1831); Williams College followed (1836); Hudson Observatory (Ohio) (1838); the Philadelphia High School (1840); the Dana House Observatory of Harvard College (1840); West Point (1841); the United States Naval Observatory (1844); the Georgetown College Observatory (1844); the Cincinnati Observatory (1845); the new observatory of Harvard College (1846); the private observatory of Dr. Lewis M. Rutherfurd in New York City (1848); the observatory at Ann Arbor (1854); the Dudley Observatory at Albany (1856), and that of Hamilton College (1856).

These dates and the summary history just given will serve to indicate the situation of astronomy in the United States during the first half of the present century. A little attention to the dates will enable the reader to place an individual or an institution on its proper background. It must constantly be kept in mind that the whole country was very young and that public interest in astronomical matters was neither educated nor very general. The data here set down will have a distinct value as a contribution to the history of astronomy in America. The developments of later years have been so amazing that we forget that the first working observatories were founded so late as 1845.

American science is scarcely more than half a century old. The day will soon come—it is now here—when we shall look back with wonder and gratitude to ask who were the men who laid the wide and deep foundations which already maintain so noble an edifice.

EDWARD. S. HOLDEN.

MT. HAMILTON, CAL., April, 1897.

* Dr. Bowditch learned to read German in 1818, at the age of 45.

*INHERITANCE OF ACQUIRED CHARACTERISTICS.**

IN approaching the subject of 'The inheritance of acquired characteristics' from

* Paper read at the Boston meeting of The American Society of Naturalists.

the plant side, I believe it may fairly be asserted that the botanist is more favorably provided with subject-matter for investigation than is the zoologist. For thousands of years plants have been grown, selected and disseminated by man, and have thus become his companions, in as true a sense as have the cat, the dog or the horse. For at least a century botanic gardens have existed in all the leading cities of the Old World, for the avowed purpose of promoting scientific information along all lines of plant life. For a couple of centuries or thereby the desire to supply novelties of a useful or decorative kind has stimulated the nurseryman to practice artificial selection, which is just Nature's method at work under high pressure and in the hands of an intelligent conductor. Finally, the botanist, when he pursues his studies afield, deals with organisms that are rooted in definite areas amid definite environments, and from which slow escape by seeding is alone possible.

The present-day student of plant biology thus has four rich sources from which to draw information for the discussion of such topics as that now before us. Unfortunately much valuable knowledge that might have been gleaned is lost to us, since its possible practical application in the future was not recognized in the past. Now the botanist, the horticulturist and the agriculturist are joining hands in an effort to gather, to preserve, and to utilize their stores of information.

Reviewing in thought his different collecting fields, every botanist must be impressed by the fact that certain types of plant are broadly associated with certain surroundings, and particularly is this true of herbaceous plants.

If he attempts to sort out these groups in his mind he will refer most of them to one of the following categories: (1) aquatics, (2) shore or littoral plants, (3) sand or xerophilous plants, (4) shade and humus plants, (5) alpine plants, (6) saprophytic and parasitic plants. Not merely could certain broad principles be laid down for each of these divisions; microscopic study would reveal that in minute details striking similarities reveal themselves in the members of each group. In what follows I do not propose to adhere to the above groupings, but will do so where advisable.

(1) *Aquatic and amphibious plants.* The Buttercup genus (*Ranunculus*) includes about 469 species, some of which are world-wide in distribution. Nearly all are inhabitants of dry or moist soil, but a few like *R. aquatilis* and *R. circinatus* are more or less aquatic. In Europe the former exhibits striking diversity, or heterophylly in the leafage, that is largely determined by the relative depth of water and strength of water current. When growing in ponds or sluggish streams the submerged leaves are dark green, flaccid usually, dissected, and devoid of stomata, but at the ends of the annual shoots and just below the flowers are several floating leaves with expanded, trilobed, light green lamina, that greatly resemble the basal leaves of many land buttercups. Stomata are present over their upper surfaces. In Eastern America the form with submerged leaves alone exists, and even where the plants may be semiterrestrial or completely so, as in the variety *cæspitosus*, the lobed leaves of the European variety do not develop. Such facts cause us to ponder the questions of adaptability and inheritance, but do not in themselves lead us far in our present inquiry.

The Bistort genus (*Polygonum*) is typically a terrestrial one, but includes one species, *P. amphibium*, of highly plastic build. When growing in rather deep water it forms flaccid leaves on long leaf-stalks, and these spring from beside glabrous stipules. On dry land firm leaves with short stalks and hispid stipules appear. These constitute

the varieties *aquaticum* and *terrestre* of some manuals. From F. Hildebrands simple but pretty experiments* we know that plants of the latter variety which have grown for years in dry places will, when submerged a few feet in water, produce shoots that bear in a few weeks the typical floating leaves. While stomata are disposed chiefly over the lower surface of the leaf in the land form, in the aquatic they exist on the upper surface.

Experiments with *Sagittaria*, *Eichornia*, *Potamogeton* and others would demonstrate that in all there is an extreme plasticity of form that permits environmental adaptibility. Comparison with all the species of each genus causes us to inquire whether one of the variation forms has not been acquired through response to stimuli, and has now become a hereditary condition? We need not now stay to answer.

(2) *Shore, littoral or halogen plants.* Abundant along the eastern seaboard is the crimson-flowered *Gerardia purpurea*, that is as variable in habit as it is in the selection of its situation. Within a distance of 100 yards, it may be gathered on a dry exposed sandy bank, and be then about 12 inches high, sparcely branched, faintly red in the leaves, and pale pink in the flowers; or on a flat shady spot in richer soil, when the stem may be 2 feet high, the leaves bright green and elongate, and the flowers pink crimson; or on a rich alluvial mud, when we get a bushy plant 3 feet or more high, that bears long narrow leaves and large showy crimson flowers. But in our botanical manuals *G. maritima* is now given as a true species. It inhabits saline coast-flats, and may even be washed by sea-water without seeming to be injured. A distinctly different plant it looks from the former. From 1 to 8 inches high, it branches little if at all, bears thick succulent reddish-green or glaucous leaves, and one or several small pink flowers.

* Bot. Zeitung, 1870.

On nearly every coast the two can be gathered in close proximity. At Oyster Bay the Shore Railroad separates a drained shore-flat with abundance of *G. purpurea* from an undrained saline swamp that is filled with *G. maritima*, while near Vineyard Haven a drain ditch forms the line of demarcation between the two. Microscopic study of both causes one to ask whether they deserve to be regarded as distinct species. The answer to this may depend wholly on what we call a species, but study of a finely graded set, gathered fully four years ago at Sea Isle, on an inclined bank, would lead me to regard them as common forms that environment has altered. If this be so we should expect that within a longer or shorter period a single individual in its life time, or seminal descendants of such as are gradually 'acclimatized,' will develop macro- and micro-scopic characters similar to those of *Gerardia maritima*. The studies of Lesage* and Russell,† amongst others, yield definite proof. Both have compared, microscopically, individuals of certain species from littoral and inland regions, and the changes undergone by the shore-grown individuals *exactly* correspond with those exhibited by *Gerardia maritima*.

Increase in thickness of the leaf substance chiefly through increase in, and enlargement of, the pallisade cells; an apparent reduction, or possibly wider dispersion, of the chloroplasts; greater lignification of the stem and leaf-bundle elements; enlargement of the vessels; reduction in size of the intercellular spaces, are typical phenomena. The culture experiments of Lesage further verify his field observations. Russell frankly confesses that those grown by him in saline solutions were not so vigorous as those from the Paris basin. Even in this, however, the resemblance to our plant is perfect.

But as Gaston Bonnier has well empha-

* Rev. Gen. de Botanique, Vol. 2, 1890.

† Ann. Sc. Nat. (Bot.), 1895.

sized in his paper on Alpine plants, and as Lesage's work shows, great caution must be exercised in discussing the morphological and physiological relations of species which may grow in close proximity. *Gerardia maritima* is 'at home,' or tries to be, on muddy saline banks, where it is usually protected by the grassy vegetation around. Though we call it a littoral plant, it is modified differently from *Cassia nictitans* or *Yucca filamentosa*, that may be its near neighbors along sand bars. The mention of Yucca can introduce us therefore to that great assemblage that we now call desert or xerophilous plants.

At times met with in full view of the ocean, they are most frequent and attain their most varied development on desert or volcanic areas. Let us linger for a little over *Yucca filamentosa*. Along many miles of the dry sandy ocean front of the Carolinas and Georgia it is a familiar plant. At one season exposed to moist saline breezes, at another to driving winds that hurl the sharp sand particles against it, during a large part of the year exposed to the full glare of hot, sand-reflected sun rays, and never enjoying a superabundance of moisture, though its roots penetrate at least five to six feet below the surface, it still survives and reproduces itself. But it is quite different to the naked eye, and still more so microscopically from the plant that we grow in rich garden soil. Specimens from the ocean beach have a dense, wiry aspect, relatively short, broad, somewhat concave leaves of a glaucous green hue and that end in a hard mucro. Garden plants, on the other hand, that have been cultivated for many years and that may have been themselves reproduced from garden seeds or suckers, bear leaves that are long, narrow and soft leathery in texture, of a dark green hue and with a soft mucro. Seedlings in the neighborhood of each type reproduce their kind.

No matter what the ancestral form may have been or what its natural surroundings, we must here admit acquired characters in one of the types that are reproduced, and our main concern again is to learn whether such changes proceed in the life-time of an individual or can gradually be acquired in either direction by seed selection and propagation. Such papers as those of Duchartre*, Elliot†, Häckel,‡ Lothelier,§ Stenstrom,‖ and notably that of Henslow,¶ furnish us with good evidence. For details of Henslow's suggestive paper I would refer you to the original, but Lothelier's studies deserve comment. He varied his experimental methods by making normal air his xerophile environment, and saturated air his new condition.

He summarizes his results alike as to sun and air exposure as follows: (a) stem and leaf substance show a greater amount of indurated tissue in a xerophile state, a reduction of this in a moist atmosphere; (b) the formation of leaf lobes, and, in such as produce them, of spines, is pronounced in a dry atmosphere; (c) the epidermal cuticle is increased, but the epidermal cells are reduced in size, the xylem is connected by a continuous ligneous sheath, and the pericycle is lignified in dry air, while in moist air these features are feebly marked or absent.

It is often stated, and in many cases truly, that the battle in the vegetable world is that of a plant against its neighbors, but with xerophilous plants, that probably cover one-sixth of the earth's surface, the struggle is entirely one between the plant and its physical or animal surroundings. Our native *Opuntia* has had its stem and branches

* Bull. Soc. Bot. de France, 1885.
† Trans. Bot. Soc. Edin., 1891.
‡ Verhand. d. K. K. zool. bot. Gesell. Wien, 1890.
§ Rev. Gen. de Botanique, Vol. 5, 1893.
‖ Flora, 1895.
¶ Jour. Linn. Soc. (Botany), Vol. 30, 1894.

shortened, its cuticle thickened, its cells filled with mucilage, its short swollen branches covered with spines, and its now small, succulent, centric leaves short-lived to the extent of a month or six weeks as a gradually perfected resistance to opposing agents. Goebel's experimental results* with the Cacti prove that removal of them to shade and moisture will materially affect their habit.

(4) *Prostrate plants.* In my paper on 'The sensitive movements of some flowering plants under colored screens,'† I described the variations constantly noted in *Cassia nictitans* when grown in the shade on rather moist loam, or in the open on somewhat retentive soil, or when fully exposed to the sun and grown in dry sand. Striking microscopic differences characterize each. This plant is but one of many that show like variations, and not a few of them can be studied as one passes along the quieter streets of our cities. The somewhat loose open growth, ascending branches and spreading leaves of *Euphorbia maculata* when it springs up in a moist shady place differs from those of the humifuse plant with flattly applied leaves that springs up between the bricks of our neglected side walks. Curiously enough, when the latter is attacked by a *Uromyces* the habit of the shade grown plant is assumed. Several grasses, *Portulaca oleracea* and *Mollugo verticillata* are all common humifuse plants when 'baked' in dry places.

(5) *Alpine plants.* Every botanist who has observantly climbed some mountain that rises abruptly from the sea front to an elevation of 3,000–4,000 feet must have been impressed with the change assumed by the vegetation as each successive 1,000 feet is surmounted. On the higher exposed elevations dense, tufted, adpressed plants with short flowering stems and white or bright colored flowers are encountered. These often exhibit close affinity with lowland species of more luxuriant growth and delicate foliage. Are these Alpines then, or the lowland ones, a product of their environment? For the present purpose it will suffice if evidence can be adduced to prove variation transitions from one to the other. Thanks to the beautiful researches of Gaston Bonnier,* supplemented by those of Dufour,† Lazniewski,‡ Leist,§ Wagner|| and Wiesner,¶ we can trace surprising variations within a short period of growth.

Bonnier divided certain plants into three or more parts; he placed one in alcohol, another in a lowland situation, and the remainder on an alpine height. The marvelous transformations wrought in the last are described in the text and faithfully reproduced in his plates. I will content myself with his conclusions. The rhizomes or other underground parts, become lengthened in order the better to store reserve-material, since the aërial period of vegetation is short but intense. The aërial internodes become greatly reduced; the leaves become smaller but considerably thicker; those species that have scattered hairs on low ground have them increased in size; the flowers are reduced in size but brightened in their red and purple colors. Equally marked are the histological changes. Here we have explained the origin of those specific varieties now designated *nana*, *alpina*, etc., which reproduce themselves by seed amid their natural surroundings. How far a plant or group of them when isolated will remain 'true,' or revert, or vary further, we have as yet no experimental data for determining. This much

* Flora, 1895.

† Bot. Central., Vol. 61, 1895.

* Ann. des Sc. Nat. 7th Ser., Vol. 20.

† Ann. des Sc. Nat. 7th Ser., Vol. 5, 1895.

‡ Flora, 1896.

§ Mittheil. der Naturforsch Gesell. von Bern, 1889.

|| Sitz. der Kais. Akad. der Wiss. in Wien, Vol. 2, 1892.

¶ Ber. der Deutsch. Bot. Gesell., Vol. 9, 1891.

can be said, that when apparently fixed species of alpines are transferred to botanic gardens, and cultivated for many years, neither they nor their seed progeny seem to vary appreciably, though it must be granted that a critical comparison has yet to be made. But the comparison which Bonnier has made* between alpines gathered on the Pyrenees, on Jan Mayen and on Spitzbergen, causes us to expect decided differences.

(6) *Parasitic and saprophytic plants.* Volumes might be written in favor of the position that these are alone explicable in terms of their environment. If the Weismannian is in straights over the origin of species amongst the sexless Fungi, more inexplicable seem the sexually perfect flowering parasites. The highly modified and recent order *Scrophulariaceæ* deserves consideration on this continent. To return to the Gerardias that are all more or less pronounced root parasites, such a finely connected series of species as *G. fasciculata*, *G. purpurea*, *G. paupercula* and *G. aphylla* show gradual degradation of the assimilatory organs, as we pass from the Northern to the Southern States. Root, stem and leaf alike all cooperate in the degradation changes. That their floral leaves undergo like reduction suggests a certain rythmic response of the entire organism to altered conditions, and if we pursue our study to those degraded types *Epiphegus*, *Conopholis* and *Orobanche* we see how perfect this response may be. But comparison of Beech Drops (*Epiphegus*) over a pretty wide area of country will afford proof that few plants are more variable, and also that in any one locality the acquired variations are reproduced by this strictly annual species.

(7) *Fasciated plants.* It is now nearly nine years since a botanical friend gathered a wild, fasciated plant of *Polemonium cæruleum* in north Scotland. Its usually slender cylindrical stem was flattened out to a width of about 1½ inches, and from it started a wealth of branches in the axils of the numerous leaves. The plant grew and seeded. Some seeds were retained by him; others were given to the Edinburgh Botanic Garden. From both a considerable proportion of fasciated plants developed. It may at once be objected here that such a teratological state was congenital in the parent plant, but, even granting this for the moment, there seemed strong evidence for its inheritance by the offspring. Long experience in north-central Europe is that fasciation is of rare occurrence. Along our eastern sea-board, especially on sandy soil, with moist substratum, it is frequent. In a single New Jersey meadow 31 specimens of the bulbous Buttercup were gathered by my student party fully four years ago, and prolonged search would have given us more. But an inspection of New Jersey sweet potatoes in the end of September will reveal that from most plants five to eight long shoots radiate outward 20–25 feet. Some are uniform, cylindrical and slender throughout, but half or more of them begin to flatten almost imperceptibly about 5–8 feet from the root region, and are the width of one's hand by the end of a season's growth. They need no further mention, since with us the sweet potato is reproduced by the tuber. But study of such lists as are given in Moquin-Tandon's and Masters' works on plant teratology indicates that plants which, occasionally at least, grow on light soil are those in which such variations occur. De Vries' valuable paper* on the hereditary transmission of fasciation is scientific proof of what every gardener knows to be true. Our now greatly appreciated garden cockscombs, are just monstrous fasciations of the wild *Celosia cristata*, that has a bushy habit, cylindrical stem, numerous leaves, thin

* Rev. gen. de Botanique, Vol. 6, 1894.

*Botanisch Jaarbok, 1894.

branches, and rather loose flower panicles. The wild plant evidently varies readily under cultivation, for several varieties have appeared that are perpetuated true from seed. But no gardener who sows his cockscomb seeds expects all or even the majority to revert to the wild ancestor, though some may more or less perfectly at times. The suggested presence of a fungus that may stimulate to fasciation requires ample confirmation before the view can be accepted.

(7) *Cultivated plants.* Hitherto indications of characters having been acquired have been drawn almost entirely from the wild state, but we must frankly acknowledge that the cases have been few where these characters have been proved to be directly inherited. In cultivated plants we have the strongest possible evidence. At the start let me emphasize the well known fact that the wild type of many of our cultivated plants is unknown. Wheat, oats, barley, corn, the banana, peach, gourd and vegetable marrow are descendants of wild plants that we are still looking for.

Man in his cultural operations has been practicing artificial selection along three lines. He has aimed, first, at a heavy return from individuals, none of which will require special care as individuals, and such we call agricultural crops; second, to obtain a rich fruit supply from individuals that need more detailed attention, and these we commonly call fruit crops; third, to develop a race of showy or handsome decorative plants. The first and second operations have been proceeding for thousands of years, and accordingly we find that the species operated on are those whose wild state we know least about. Be it noted here, however, that artificial selection is very different in its results from the rigorous and impartial selection that works its course in nature. In the latter case those forms survive that are balanced to, or that rise superior to, their environment. In the former man steps in, selects not those types that are hardiest, and in general features fittest for life's battle, but those only which show variations that please him. Such may be the very opposite of desirable in a struggle alongside other plants, or amid such physical conditions as the plant might averagely be exposed to. No wonder then that when man steps out and leaves to their fate the new species that he has evolved, Nature steps in and makes 'short shrift' of them.

Here let me say that many of our most keenly debated biological questions will be largely settled for us in the near future by a diligent study of horticultural and agricultural literature, which, though at times loose, hazy and lacking in exact detail, brings us nearer to the subjects of variation and heredity than does much of our botanical literature. The use that Darwin, Masters, Henslow and Bailey have made of it we all know.

It is impossible in so vast a field to do more than refer to one or two cases. At the World's Fair Horticultural Congress M. de Vilmorin read a paper that in some points settles for us our position in the present debate. Selecting one of the most unlikely of European weeds, the wild Chervil (*Anthriscus sylvestris*), he sowed seeds of it in a selected situation, "in order," says he, "to change its slender and much-forked roots into fleshy, straight and clean roots, say like those of the parsnip. Among the first batch of roots raised from wild seeds a dozen were selected with a tendency in their roots to larger and straighter bodies. Each root was planted separately, and its seed harvested separately. Of the dozen lots obtained, 8 or 9 were discarded at once, and roots were selected only in such lots as exhibited some trace of variation. Again a dozen roots were chosen, a drawing made of each root, which was afterwards planted

separately. For the first ten years the changes were slight, but now they are more and more marked with every generation, and in some of the lots the straight and smooth roots are the most numerous."

Let us briefly trace the history of the Chinese Primrose, which was introduced into English gardens about 1820, but whose natural habitat became known just seven years ago. A variable plant in the wild state, found growing on dry calcareous rocks that are exposed to the broiling sun, it might seem to give little promise of reward for horticultural skill. The first two batches of seedlings reared greatly exceeded expectations, but for years these were propagated chiefly by offshoots. Now garden seeds are entirely used, and few could identify the horticultural prize-taker with the wild specimens collected for the first time a few years ago by Dr. Henry and the Abbe Delavay.

As a somewhat different method of inquiry we have Schindler's comparisons of wheat of the same variety grown in different regions of the world. He finds that the relative amounts of starch and protein vary according to the locality, though samples taken from any one region closely resemble each other.

(9) *Graft plants.* In the literature of gardening the question has often been debated whether the stock and graft reciprocally influence each other. Except in a few rare cases, the negative position has usually been taken, but the experiments of Daniels*, if confirmed and extended, will go far to demonstrate that deep-seated modifications may take place which can be transmitted by seed. When he grafted the cultivated turnip on the wild garlic mustard (*Sisymbrium Alliaria*) the seeds of the turnip produced plants that inclined more to the wild stock. He next reversed the process by growing the wild plant on a cultivated stock. He grew plants of the garlic mustard; some of them he allowed to grow on as control plants; others he grafted on the cultivated cabbage. Seeds were saved and sown from both lots. The former faithfully reproduced the features of the wild parent. Plants reared from the graft garlic seeds were not so tall, the leaves were not so crowded and bore a distinct resemblance to the cabbage, they were of a deeper green color, somewhat plaited, gave a less marked odor of garlic and something of the odor of cabbage. The roots were less woody, the medullary parenchyma was less thickened, the vascular cylinder was reduced but the bast was increased, the bark was more delicate, the chlorophyll more abundant, and the intercellular spaces were reduced as compared with the wild parent.

(10) *Cecidial and domatial plants.* We now approach a subject that is still involved in considerable obscurity, but the bearing of which we believe will greatly aid us in the study of many cell phenomena. Plant galls, or *Cecidia*, in the restricted application of the term, include those outgrowths on leaves or shoots that are caused by insects or mites which undergo development within masses of vegetable tissue, this tissue being produced through excretion of a chemical substance by the hatched grub. Though varying greatly in size, form, consistency and relative abundance, they agree in that the type of tissue built up by the infested plant is diagnostic of the particular species of insect whose egg was deposited. It is not at all uncommon to find eight to ten different galls on one shrub or tree, each rearing a distinct insect species within.

While these have long been known to naturalists, it is only within the past 20 years that attention has been increasingly turned to *Domatia*. These are plant-

* Rev. Gen. de Botanique, 1894; Comptes Rendus, 1892.

growths that attract insects—commonly ants—by offering to them some bait, such as watery liquid or honey. In return the ants commonly act as a body-guard or garrison, and thus protect the entertaining plant from being browsed down by insect enemies. From the investigations of Belt, Beccari, Delpino,* Forbes, Schumman, Treub and others, we now count the number of these as at least 3,000. They fall, however, under two distinct categories: (1) Domatia which are merely extra-floral nectaries, and which may be modified stipules, or may be outgrowths over twigs and leaf surfaces. (2) Domatia in which the entertained insects puncture or excavate some part of the plant. As an outcome, definite holes, cavities or galleries arise, from which plant liquids may escape, or in which the insect-garrison may be appropriately housed. From the researches of Molliard† and Rathay‡ it appears that transition combinations—and some of them very funny—can be traced from *Cecidia* to both kinds of *Domatia*, but in all we have acquired characters of a remarkable kind. It always appeared to me peculiar and somewhat inexplicable, that neither of these should be, so far as our knowledge went, transmissible by seeds. One may cut open thousands of *Cecidia* in their season—chiefly spring—and always the swelling is found to be tenanted by the inciting cause—the insect. The publication of Lundström's paper§ was a welcome one therefore, for, though we could wish for wider verification, his statements seem to be cautiously made. Experimenting with *Rhamnus alaternus* that forms cavernous domatia inhabited by mites, he found that seeds infested by the mites produced seedlings on which the animals propagated rapidly, and at once formed their burrows, while other seeds, selected and cleaned, gave rise to plants that at first showed no signs of domatia, and had no mites, but the later-formed leaves developed the domatia as usual in the axils of the leaf veins. These were smaller and poorer in hairs than the normal growths, but showed no trace of mite.

Equally striking is the history of the well-known Javan plant, *Myrmecodia tuberosa*, and even if we accept with Treub that a small swelling and water canals exist in the unpunctured swelling it seems to me extremely likely that this is acquired and hereditary. My reasons for this opinion are founded on the history of a Bornean pitcher plant, *Nepenthes bicalcarata*, which I have studied from cultivated and from dried imported leaves. First introduced to science and cultivation by Mr. Burbidge, it is now grown in collections and thrives well. At the junction of the tendril with the pitcher and parallel to the latter is an elongated fusiform swelling. About the middle it is pierced, in the wild state, by a neat circular orifice that leads into a cavity resulting from breaking down of soft, loose, water-conducting cells. In the cavity ants reside, and can safely sip the juice that percolates from the liquid-filled pitcher—cavity alongside. I have examined a considerable number of cultivated plants, and on every leaf was a decided swelling filled internally with soft cells. No other species of *Nepenthes* exhibits such an enlargement. Whether cultivated seeds would reproduce the acquired character we are not yet in a position to say.

As regards *Cecidia*, we know that these arise, not immediately after the plant tissues have been punctured by the insect when ovipositing, nor after the egg has been deposited, but only when a larva hatches and exudes some specific irritant. That this irritant should, nevertheless, start in the plant a formation of embryonic tissue that develops in as definite a manner as if it

*Mem. R. Accad. Sc. Ist. Bologna, Vol. 8, 1888.
†Ann. des Sc. Nat., Vol. 1, n. s. 1895.
‡Sitz. K. K. Zool. Bot. Gesell. Wien, 41, 1891.
§Nova acta R. S. Sc. Upsal, Vol. 13, 1886.

were a normal growth of the plant, and which yet, as Molliard has pointed out, produces formations different from the normal tissues, is proof that the protoplasmic reaction of somatic cells to definite chemical stimuli is as exact as it is profound. To cite one concrete example from many that Molliard gives, it can be said that *Arabis sagittata* when attacked by an Aphis shows:—

(*a*) An abundance of hairs of special form on all the organs.

(*b*) A coloration due to a pigment-liquid in the epidermal cells.

(*c*) Longer life of the floral organs.

(*d*) Hypertrophy of cells.

(*e*) Transformation of tissue of varied consistency, into a uniform parenchyma.

(*f*) Death of the sexual cells.

In a condensed paper like this it is impossible to touch on such subjects as the origin and transmission of plant colors, of many heterophyllous modifications, of floral numbers and of floral form, nor can we treat of plant hybrids, of which probably 6,000–7,000 are now known.

I would sum up the position by saying that, while in the earlier illustrations used by me evidence was advanced which favored the idea of characters being acquired even in the life-time of an individual and that represented direct environmental adaptation, in later illustrations, such as those furnished by some xerophilous, some domatial, many cultivated and a grafted plant, direct proof exists of acquired characteristics that are hereditarily transmitted by seed. I have not considered it necessary to speak of bud variations and their seminal reproduction, as these have been so fully dwelt on by Darwin and recently by Bailey. The Neo-Darwinian position seems to me superfluous, because it explains nothing on an exact basis of cause and effect. It is easy to say, when variations or evidences of new adaptability appear in a plant, that these are but the expression of previously latent potentialities, or of variations first contracted or assumed by the germ plasm, and that subsequently exhibit themselves in the somatoplasm. Possibly were the eyes of our understanding enlightened we might discover the budding possibilities of an orchid or an oak in an alga, but before accepting such possibilities it may be well to see whether the Lamark-Darwinian principles cannot guide us perfectly and sufficiently far. Here, however, I would suggest, in contradistinction to Wallace, that indefinite variation must be allowed for. Every plant is a structure built up of extremely complex chemical bodies that are being acted on by external and internal stimuli. We can scarcely suppose that new or modified stimuli are always productive of good and good only. Rather should we consider that in each little plant world, as in our larger physical world, volcanic explosions occur that are in one sense a source of safety for the future, but which leave behind beds and streams of debris that may be useless or even destructive. Various of the plant colors, resins, crystals and other frequent compounds may be explicable primarily as side issues that were for the time useless, even though, as in the compounds just named, we find that they now function beneficially in the plant economy.

Every candid examiner of the facts must admit, however, that sudden and several variations often appear in individuals placed side by side with their like that show no change. I do not see that we possess at present a sufficiently exact knowledge of all the possible factors that may start variation to enable us to explain these. Still this should be no deterrent to our accepting the position that generally explains ascertained facts of structure and function.

It now remains for me to say a few words, as a student of plant cytology, on some of the theories that have been advanced to ex-

plain heredity. Darwin's theory of pangenesis has been pushed aside as a cumbrous impossibility, or at least improbability. Even the modified theories of De Vries and others are only tolerated. Weismann's view, that the chromatic substance is the bearer of heredity, has nearly everything to be said in favor of it, if it be accepted that this substance is found in every living cell. But even then, according to the Neo-Darwinian, it has only a very remote connection with the somatic micellæ. Before resuggesting what has seemed to me a good position that explains details of structure, I may be allowed perhaps to become one more of the number of those who have attempted to rehabilitate Darwin's pangenesis hypothesis.

The wandering of his gemmules to and from definite positions has seemed cumbrous and unlikely, but the most fundamental law of plant and animal physiology is circulation, metabolism and ultimate assimilation as the physiological groundwork of life, growth and heredity. On the plant side physiologists have only realized within the past quarter-century how potent and generally present are ferments of diverse composition and action. Thanks to the labors of Green, Chittenden and others, we further know that highly complex nitrogenous compounds are readily converted from solid into liquid form, and can migrate, in an as yet often mysterious manner, to definite centers of nutrition to be again converted into solids. So far as my knowledge of physics and chemistry leads me, there is no obstacle to our admitting that transfers of complex dissolved materials are passing to the protoplasm, and through it to the chromatin of every cell, more or less affecting its micellar structure. It is necessary, therefore, to learn what relation, if any, exists between the chromatic and plasmatic substance of cells.

In such plants as *Spirogyra* and *Dionæa* I regard the chromatic substance as being demonstrably continuous from the nucleolus through the nucleoplasm to the cytoplasm, where connections are made with the chromatic center of each chloroplast. The so-called pyrenoid-centers in *Spirogyra* behave to stains and reagents as does typical chromatin substance, while radiating chromatic threads pass from them to the nuclear chromatin. Furthermore, in *Spirogyra* an extremely fine chromatic thread-work joins the pyrenoid centers in it transversely or obliquely. What the finer invisible terminations of it in the protoplasm may be, we cannot say, but it appears to me that, if physico-chemical laws are not to be thrown aside, it is a necessity of the case that the delicate chromatic endings in the protoplasm are being acted on, and more or less modified according to the nature of the stimuli that travel to them. As a result of this, a slow, steady but appreciable modification will be effected in the reproductive cells which epitomize the molecular structure of the entire organism that produces them.

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CURRENT NOTES ON PHYSIOGRAPHY.

UPLANDS AND VALLEYS OF KANSAS.

THE second volume of the University Geological Survey of Kansas concerns the western part of the State, occupied by Cretaceous and Tertiary formations. The physiographic matter is contributed by Haworth; the geological descriptions by Prosser and Logan. The Tertiary lies unconformably on the broadly eroded Cretaceous. The surface of the latter, north of the Arkansas and west of the paleozoic area, presents three ragged east-facing escarpments of moderate height at the margins of the Dakota sandstone, Benton limestone and Fort Hays limestone, with intervening plains gradually ascending west-

ward. The Tertiary, mostly composed of sands and gravels, hundreds of feet in thickness, derived from the Rocky mountains, is explained chiefly as river wash, and not as a lacustrine deposit. Its eastward margin is marked by an irregular escarpment formed on the 'mortar beds' (sand or gravel with calcareous cement). Its general surface, away from the river valleys, is broadly even. Faint depressions or swales occur, holding water for a month or so in the year; they are ascribed to unequal settling of the strata, followed by underground leaching. A further stage of this process is seen in the 'arroyos,' slight depressions of the surface with continuous descent, like stream channels, but broad, grassy and flat, with low bluff-like rims up to their very heads.

The uplands with their escarpments are much dissected by the rivers, giving local relief of 250 or 300 feet, and a greater variety of scenery than is commonly associated with the Great Plains; yet it seems something of an exaggeration to say of this treeless region that "near any of the drainage streams one almost invariably finds a varied and pleasing landscape which in many respects is rarely surpassed in America." Even some of the larger rivers are of inconstant flow; for example, the Cimarron river 'has water in it throughout the greater part of the year in most of its course.' Bear and White Woman creeks, one south, the other north of the Arkansas, enter the State from Colorado in well-cut valleys, and after heavy rains possess a large volume of water with much sediment; but their valley sides decrease in height down stream, and at last the waters and sediments are spread out on the even uplands or lost in the sand hills, without joining any other river. Smoky Hill river is working on bed rock for much of its course; but the Arkansas has heavily aggraded its valley. The report is illustrated with a number of photographs, whose value would have been greater had they been taken when possible from higher points of view. The last of a number of plates gives a bird's-eye view of the State, with geological areas, rivers, and county boundaries marked on the surface and vertical sections on the margin, of much service in elucidating the text.

BELL ON CANADIAN RIVERS.

Robert Bell, of the Canadian Geological Survey, discusses the 'Evidences of northeasterly differential rising of the land along Bell river' (Bull. Geol. Soc. Amer., VIII., 1897, 241–250), which flows northward from the upper Ottawa to Hudson Bay. Good proof is given that the upper Ottawa crossed the present height of land in postglacial time and followed the Bell; and that its diversion to the St. Lawrence is due to a rise of the land in the north or northeast still in progress. Some of the ragged expansions of the rivers, forming lakes, which are commonly explained as the result of drift barriers, are ascribed by Bell to backwater flooding in consequence of the tilting of the land. The small relief of the region and the low divides between the rivers, combined with the resistant character of the ledges where crossed by streams, are all favorable to these results. The Bell river, flowing towards Hudson Bay, has acquired a low-grade course through a clay-covered lowland of till; it is here and there interrupted by rapids on hard ledges. At present the water becomes deeper (even thirty or forty feet), the stream broader, and the banks less defined in going up stream from from one fall to the next; and this is well interpreted as a result of uplift in the north. The out-branching 'lost channels' of various east- or west-flowing rivers are generally found on the south side of the main stream. The Churchill River seems to be on the verge of spilling over south-

ward at Frog portage, 500 miles from its mouth, and running to the Nelson. Altogether, this is a most interesting and valuable contribution to the natural history of rivers.

THE PLATEAU OF WEST VIRGINIA.

A REPORT by M. R. Campbell and W. C. Mendenhall, dealing primarily with the 'Geologic section along the New and Kanawha rivers in West Virginia' (17th Ann. Rep. U. S. G. S., Pt. II., 1896, 479–511), includes a brief account of the physiography of the plateau thereabouts, with a number of excellent illustrations from well selected points of view. The river canyon, for such it truly is in spite of its occurrence east of the 100th meridian, is a full thousand feet deep, with forested walls descending at angles of 35° or 40° to a narrow valley floor. Where the river cuts down upon harder sandstones it has not yet developed a graded channel; elsewhere it has narrow belts of flood plain, now on this side, now on that. The canyon is sharply cut in a Tertiary peneplain that was well smoothed for a number of miles on either side of the river, but further away the upland is interrupted by knobs and ridges that rise distinctly above it. The dissection of the peneplain was permitted by a broad arching uplift late in Eocene time, its present altitude being 2,600 feet near Hinton, but of less amount to the southeast and northwest. The river fortunately maintained its antecedent course across the broad arch, and thus opened the important highway through a region that would otherwise be difficult to traverse. Agriculture has lost much in the conversion of the smooth peneplain into a dissected plateau, but mining has made corresponding gains in the exposure given to numerous coal beds on the valley sides.

CRATER LAKE AND MT. MAZAMA, OREGON.

AN account of Crater Lake, by Diller (Amer. Journ. Sci., III., 1897, 165–172) notes that the Mazamas, a society of mountain-climbers of Portland, met at the lake last summer and gave their name to the vanished cone, now replaced by the superb caldera. So far as I know, this is the first instance of giving a special name to a vanished volcano, although the habit of naming extinct lakes is now common. Besides the evidence from truncated lava beds and headless valleys, which points so unequivocally to the loss of the Mazama cone, Diller adds evidence from glaciation. Not only are there moraines in the valleys two to five miles down from the river, but the topmost rocks of the rim are planed off and striated on the outer slope, while the cliffs turned toward the lake have angular and broken faces. The ice, therefore, came from a higher source than any now present, and, judging by the extent of the glaciation, Mazama was in the glacial period a rival of Shasta and Rainier for the supremacy of the range. It was still active during the presence of the ice; for on the northeastern rim a glaciated lava flow covers two layers of pumice separated by a sheet of rhyolite, and all these lie on an older glaciated surface. It is suggested that the heavy deposits of waste that occupy the lower radial valleys were washed down by floods that were caused by eruptions from the snow-capped mountain. The caldera is explained by the withdrawal of the deep lavas, followed by a great cave-in of the upper cone. An edition of the Crater lake topographical sheet, published by the Geological Survey, has been printed with a number of excellent photographic views on the back.

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HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

MAN AND HIS ENVIRONMENT.

TWO of the lectures at the National Museum, reprinted in the last Smithsonian Re-

port, are on man and his environment. Major J. W. Powell addressed his audience on the 'Relation of Primitive Peoples to Environment, Illustrated by American Examples,' while Professor O. T. Mason chose as his topic 'The Influence of Environment upon Human Industries or Arts.'

It is needless to say that both lectures are learned and instructive. Major Powell explains the origin of the activities of culture and their modification by the qualities and properties of external existences. He refers to those forms of environment which appear as institutions, opinions and languages, and weighs their values.

Professor Mason begins with man's cosmic environment and its influence on his industrial activities, and devotes his chief attention to the especially American environments and their association with aboriginal industries. The table which he presents in this connection is clear, full and suggestive.

There is no question of the high value of such thoughtful contributions as these to the science of man. But sometimes there is a danger that man himself may be lost to sight in the contemplation of his surroundings. Forty years ago Draper and Buckle saw nothing in man but a creature of environment; whereas, to-day, the highest note of anthropologic science is to chant the victory of man over his environment by the powers of his psychical nature.

SLAVERY OF THE AMERICAN INDIANS.

In the study of native American ethnography the question of human slavery has important bearings. Before the discovery, it prevailed in Mexico and northern South America, perhaps on the northwest coast. The Spanish adventurers did not hesitate a moment to enslave the Indians, but neither the monarchs of Spain nor the Catholic clergy authorized such proceedings. The latter, indeed, notably Father Montesinos and the famous Las Casas, protested against it in the strongest terms, as has been again shown by Dr. Marc F. Vallette, in his 'Studies in American History.'

An article on 'Canadian Indian Slavery in the Eighteenth Century,' in the *Proceedings* of the Canadian Institute, February, 1897, by Dr. James B. Hamilton, proves that Indian slaves were quite numerous there until within the present century, and, according to the Abbé Tanguay, were found also among the Catholic population. They bore the name *Panis*, that is, Pawnees; as it seems that members of this tribe were captured by the Algonkins and sold to the early traders, whence all enslaved Indians came to be so called.

None of the northern tribes, however, was successfully reduced to a state of bondage, and this accounts largely for their destruction as a race.

D. G. Brinton.
University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

At the conversazione of the Royal Society, May 19th, among interesting exhibits was one by C. T. Heycock and F. H. Neville of a curious alloy of silver and zinc, "which would have warmed the hearts of the old-time alchemists." This alloy is of the ordinary color of silver, but when warmed up to 300° C. and then suddenly cooled it becomes the color of copper. On reheating and cooling slowly it resumes its original color. The same effect is produced by heating in air, in hydrogen or in a vacuum.

The *Chemical News* quotes from the Sanitary Chronicles of the parish of St. Marylebone, for the month ending March 31, 1897, the reports of work done by Dr. Winter Blythe on the disinfecting properties of formaldehyde, commonly known in solution as formalin. One part in ten thousand suf-

fices to preserve milk, soup and similar articles for a considerable time. The aqueous solution, when exposed in dishes, has a tendency to polymerize, its disinfecting qualities becoming by this much impaired. It is as a gas that formaldehyde exercises its valuable properties most efficiently. A comparative trial was made with sulfur dioxid and formaldehyde in two rooms in which various bacilli were exposed. The growth of the typhoid bacillus and the anthrax bacillus were not prevented by sulfur dioxid, but were by formaldehyde. The fumes of formaldehyde are very irritating to the eyes, but in general are far less disagreeable than those of burning sulfur. In conclusion, Dr. Blythe considers that formaldehyde is superior to sulfur dioxid as a disinfectant, and recommends its adoption by the vestry of the parish.

OBSERVATIONS appear to show that the proportion of argon in exhaled air is slightly less than that in inhaled (1.21% as against 1.186%). It had been suggested as possible that argon formed a compound with the hemoglobin of the blood. This seemed the more probable from the fact that when analyzed by the Kjeldahl method, where the nitrogen is converted into ammonia, the amount of nitrogen obtained from hemin is less than that by the Dumas method, where the nitrogen is measured absolutely. In the last *Berichte* J. Zaleski, of St. Petersburg, describes careful examination of preparations of the coloring matter of the blood for argon, but in no case was a trace of argon found, so that some other explanation must be sought for the analytical differences.

THE constitution of phosphorous acid has been a matter of doubt, for though much evidence points to $OPH.(OH)_2$ its formation by the action of water on PCl_3 points to $P(OH)_3$. The ester $P(OC_2H_5)_3$ is known, being formed, however, not from the acid, but by action of $Na(OC_2H_5)_3$ on PCl_3. Michaelis and Becker describe in the last *Berichte* the formation of an isomeric ethyl ester directly from phosphorous acid by the successive action of lead acetate, giving lead phosphite; ethyl iodid, giving diethyl phosphorous ester; metallic sodium, replacing the hydrogen atom, and ethyl iodid, giving $OPC_2H_5.(OC_2H_5)_2$, the diethyl ester of ethyl phosphinic acid, a compound differing materially from its above mentioned isomer $P(OC_2H_5)_3$. From this it appears very probable that the true constitution of phosphorous acid is $OPH.(OH)_2$ with quintivalent phosphorus, and not $P(OH)_3$, with the phosphorus atom trivalent. Reasoning from analogy the constitution of hypophosphorous acid would be $OPH_2.OH$, which has long seemed probable.

DISCUSSION has been carried on in the *Berichte* between Dr. Emmerling, of Charlottenburg, and Dr. Gosio, of Rome, as to the cause of poisoning from fabrics, as carpets and wall papers, containing arsenic. Several moulds are known to flourish on media containing solid compounds of arsenic, among them *mucor mucedo* and *aspergillus glaucus*. In *penicillium brevicaule* Dr. Gosio finds a mould which, grown on a medium containing arsenic, evolves a volatile substance with the characteristic garlic odor of volatile arsenic compounds, and which was instantly fatal to a mouse. The nature of this compound is, however, undetermined, and Dr. Emmerling doubts its existence. His doubts are based on the fact that he has obtained no evidence of its existence, using the *mucor* and the *aspergillus*, though he has not experimented with the *penicillium*. It is to be hoped that others will succeed in obtaining the volatile arsenic compound if it really exists, and settle finally this long controverted point in toxicology.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

Efforts are being made to collect $50,000 to purchase for the Philadelphia Academy of Natural Science the paleontological collections of the late Professor Cope. The sum of about $5,000 has been already received. It would be especially appropriate that these collections should be secured by the Academy, where the proceeds of the sale will be used for the foundation of a chair of paleontology.

A bronze bust of Maria Mitchell has been unveiled in the Observatory at Vassar College. It was cast by the Gorham Silver Company from a plaster bust made in 1877 by Miss Mary Brigham.

Dr. James Hall, the Geologist of the State of New York, is to sail for Europe on June 24th, to attend the coming meeting of the International Geological Congress at St. Petersburg as a representative of the State.

Lord Lister and Professor Max Müller have been elected members of the Imperial Academy of Sciences of Vienna.

Dr. Eduardo Wild, formerly Minister of Justice and Minister of the Interior of the Argentine government and now professor in the Buenos Ayres University, is in the United States as part of an extended tour with the object of investigating educational institutions.

Mr. Frederick L. Ransome has been appointed Assistant Geologist in the U. S. Geological Survey.

A memorial to Joseph Thomson, the African explorer, was unveiled at his birth place, Thornhill, near Dumfries, Scotland, on June 8th. The memorial consists of a pedestal with basreliefs and a bust in bronze of Thomson executed by Mr. Charles McBride. It is proposed further to present a repliqua of the bust in marble to the Royal Geographical Society.

A commemorative tablet to the eminent French botanist Duchartre was, on May 23d, placed on the house at Portiragnes, where he was born in 1806.

The Epidemiological Society of London has collected funds for a Jenner medal, the design for which has been entrusted to Mr. Allen Wyon.

Karl Remigius Fresenius, the eminent chemist, died at Wiesbaden on June 10th. He was born at Frankfort-on-the-Main in 1818, and had been, since 1845, professor of chemistry in the Agricultural Institute at Baden.

Mr. Alvan G. Clark died at Cambridge on June 9th, aged sixty-four years. Astronomy is deeply indebted to the senior Alvan Clark, who died in 1887, and to his two sons. In 1859 Mr. Clark began the making of an object glass eighteen and one-half inches in aperture, the largest that had up to that time been attempted. In 1873 the firm made the twenty-six-inch objective for the observatory at Washington, and in 1880 the thirty-inch refractor for the Imperial Observatory at St. Petersburg. These were followed by the thirty-six-inch lens of the Lick Observatory and the recently completed forty-inch lens for the Yerkes Observatory. The making of such lenses was a scientific work of the utmost value, and Mr. Clark had also made direct contributions to astronomy, including the discovery of the companion of Sirius in 1862, for which he was awarded the Lalande Medal of the Paris Academy.

We also regret the following deaths: Dr. William Thompson Lusk, President and professor of gynæcology in the Bellevue Hospital Medical College, New York, and the author of many important contributions on gynæcology, died on June 12th. Mr. Richard Christopher Rapier, an eminent British engineer, died on May 28th, aged 61 years. Mr. Ney Elias, who made important geographical explorations in Asia, died on May 21st. Privy Councillor von Falke, formerly Director of the Austrian Museum of Art and Industry, died on June 12th, aged 72 years.

Ginn & Co. make the important announcement that they will publish in the course of the present month the first number of *The Zoological Bulletin*, a companion serial to the *Journal of Morphology*, designated for shorter contributions in animal morphology and general biology, with no illustrations beyond text-figures. It is to be expected that there will be sufficient material for at least six numbers a year of about fifty pages each, form and style to be the same as the *Journal of Morphology*, so that articles in whole or in part can be easily

transferred in case of need. The *Journal* will be edited by Professors C. O. Whitman and W. M. Wheeler, of the University of Chicago.

Natural Science completes its tenth volume with the current number, and will hereafter be published by J. M. Dent & Co., London. *Natural Science* has undertaken the somewhat difficult task of publishing each month an extended series of anonymous editorial notes and comments. These have always been independent and interesting; indeed, the journal throughout has demonstrated that science need not be dull. *Natural Science* has given more space and more intelligent appreciation to the results of American science than any other foreign journal, and should have a large circulation in the United States.

IN addition to the parties under Prince Luigi Amadio and Mr. Henry G. Bryant, now attempting the ascent of Mt. St. Elias, we are informed that a party from the London Alpine Club and the Boston Appalachian Mountain Club will carry out explorations in the Canadian Alps, with special reference to the snowfield of the Continental Divide.

PROFESSOR WILLIAM LIBBEY, with a party from Princeton University, expects to explore during July a mesa or sandstone table land near Albuquerque, N. Mex. The mesa rises from the plains to a height of more than 7,000 feet and has hitherto proved inaccessible, although it is thought to contain archæological remains.

PROFESSOR GEORGE H. BARTON finds that he is unable to accompany Lieutenant Peary this summer, and the expedition will not include the party from the Massachusetts Institute of Technology.

THE steamship *Windward* has left London for Franz Josef Land in order to bring home the members of the Jackson-Harmsworth expedition, who have now spent three winters near Cape Flora. The steamship takes with it special stores to be left at Elmwood, in case Dr. Andrée should be compelled to seek safe quarters in Franz Josef Land.

ACCORDING to Reuter's Agency, Captain Sverdrup has abandoned his original intention of exploring this year the unknown tract between Franz Josef Land and Spitzbergen. His plan now is to go up to Smith Sound, advancing along the northwestern part of the coast of Greenland, and to spend the winter in exploring on sledges that country and the American side of the North Pole generally, thus supplementing the *Fram's* exploration of the Asiatic and European side. It is understood that Professor Mohn and Dr. Nansen approve the plan, for which an appropriation of 20,000 kroner has been asked from the State funds, the rest having been subscribed privately.

THE daily papers report, how correctly it is not possible to state, that Mr. F. W. Christian has returned to Sydney after two years spent in exploration in the South Sea Islands, having discovered ancient records, hand work and weapons that prove that the Asiatic races traded in the Islands, and that the ancient Chinese immigrated and colonized there and thus reached Central America.

MR. FREDERICK H. BLODGETT, Secretary of the New Jersey State Microscopical Society, writes us that the twenty-eighth annual meeting of the Society was of special interest. After some opening remarks by the President, Dr. J. Nelson, Dr. H. C. VanDyck explained his projection microscope for polarized light, and a series of slides was exhibited by Dr. A. H. Chester. A large number of table exhibits was shown by members of the Society.

AMERICAN physiologists, attending the meeting of the British Association at Toronto, should not fail also to be present at the Montreal meeting of the British Medical Asssciation, which opens on September 1st. The subjects taken up for special consideration by the Section for Anatomy and Physiology are: Anæsthetics, the Teaching of Anatomy and the Causes and Modifications of Heart-beat. The President of the Section is Dr. Augustus Waller, London; the Vice-Presidents are: Drs. F. Shepherd, Montreal; T. Wesley Mills, Montreal; A. B. McCallum, Toronto; A. Primrose, Toronto, and J. B. A. Lamarche, Montreal. The Honorary Secretaries are: Drs. Robert Hutchison, J. M. Elder and W. S. Morrow.

THE thirty-fifth University Convocation of the State of New York will be held in Albany on June 28th, 29th and 30th. The subjects selected

for special discussion include science teaching, in which Professor W. M. Davis and Professor Geo. F. Atkinson will take part, and the American University with special reference to a National University at Washington.

Governor Black has signed the bill appropriating $126,600 for the enlargement of the buildings of the Craig colony for epileptics.

The new tunnel under the Thames at the East End of London, constructed under the auspices of the County Council, was opened on May 22d.

The *American Naturalist* states that Drs. Maxwell and Swan, of Monmouth College, Illinois, propose to organize a summer school of biology, which will be probably located on the Mississippi River, not far from Monmouth.

It is said that a bill has been introduced in the Minnesota Legislature providing for the appointment of expert witnesses, and that the homeopathic physicians have, with legal advice, prepared a bill to be presented to the New York Legislature. The object of the bill is to provide a list of experts from whom witnesses are to be selected by the Court and paid by the State. The employment of expert witnesses by the counsel for the prosecution or defence has been unfortunate both for the Courts and for science. It would certainly be desirable to devise a plan by which the expert witness should be in the position of a judge rather than that of a paid attorney.

The unfortunate relations of politics to science are illustrated by the following note from the New York *Tribune*: "Senator Elkins and Representative Dovener, of West Virginia, had a talk with the President about West Virginians. They introduced George Bowers, a candidate for Fish Commissioner, and Alexander Campbell, who wants a Deputy Auditorship. It is stated that there are numerous applicants for Fish Commissioner, but at the same time it is stated that Commissioner Brice stands well at the White House. Many prominent Republicans have requested that he be retained, and have pointed to his services as having been decidedly satisfactory. It is hinted that the President will make no change, if at all, without giving thorough consideration to the idea of retaining Mr. Brice."

The United States Civil Service Commission announces that it will hold a special examination on July 28th for establishing a register from which appointment may be made to the position of Assistant Chief in the Division of Soils in the Agricultural Department. The salary of this position is $1,800 per annum and men only are eligible. All applicants are required to submit to the Commission, not later than July 15th, an original essay, either printed or in manuscript form, consisting of not less than 5,000 words and containing a thorough treatment of the subject 'Environment as affecting the yield, quality and time of ripening of crops.' This paper should fully cover the relation of climate, soil and other conditions to the functions of plants, with special reference to the commercial aspect of the subject. Only those applicants who submit satisfactory essays will be admitted to the remainder of the examination, which will be held on July 28th. The subjects and relative weights of the examination will be as follows:

Plant physiology	3
Climatology	2
Soils	2
Crops (including production and marketing)	2
Languages, German and French, (Translated into English)	1
Essay	10
Total	20

All persons desiring to compete in this examination should write at once to the United States Civil Service Commission at Washington, D. C., for blanks and further instructions.

Dr. H. Carrington Bolton recently called the attention of our readers to a patent allowed by the British office for making gold. An application for a patent to convert baser metals into gold has been made to our patent office, but it appears that the Treasury Department undertook to test the process and that the patent has so far been withheld.

We learn from the London *Times* that the Select Committee of the House of Commons appointed to inquire into the administration of the museums of the Science and Art Depart-

ment has presented an interim report calling attention to the peril of destruction by fire to which the priceless collections at the South Kensington Museum are exposed. After describing the general character of the buildings and their inflammable structure, the report goes on to observe that the reason why the structural alterations necessary for the protection of the collections from fire have not been made appears to be that the completion of the permanent buildings has always been in the contemplation of successive governments, and the committee regard it as their immediate duty to lay before the House of Commons their very strong opinion that permanent buildings for the adequate accommodation of the collections at South Kensington should be proceeded with without delay.

A THIRD exhibition of recent geological work was opened on June 1st at the Paris Museum of Natural History. The *Times* states that England contributes some geological charts and India some meteorites. M. Schuck sends specimens of Transvaal auriferous rocks; M. le-Feuvre, Chilian nitrates; M. Chaefanjon, Central Asian rocks and Chinese coal; M. Chauvau, Madagascar gold ore, and the Dutch government a large geological chart of Java.

THERE will be held at Berlin in October an International Congress on Leprosy, to which the United States Department of State has been invited to send delegates.

THE daily papers report that the movable floor of the great dome of Yerkes Observatory fell 45 feet on May 29th. The damage is confined to the floor and the machinery immediately connected with it. The cause of the accident has not yet been announced.

IN view of the 20th annual convention of the National Electric Light Association, which opened on June 8th at Niagara Falls, the *Electrical World* gives an elaborately illustrated review of the electrical installation of the Falls. The total horse power of the Falls is estimated at about 2,500,000, of which about 52,000 will be required for the present installation. This will lower the level of the Falls by about two inches. At the present time the electro-chemical industries use 11,000 horse power, of which the most important are those for the manufacture of aluminium, carborundum, sodium and calcium carbide.

WE learn from *Natural Science* that a large addition is being made to the Bergen Museum. To the cost, which will exceed $40,000, the Norwegian government has contributed half, while smaller sums have been given by the municipality of Bergen and by private persons. The number of visitors to the museum was over 50,000 in 1896.

A LABORATORY of experimental phonetics has been established under the chair of comparative philosophy of the Collège de France.

THE new Medical School buildings of Guy's Hospital, London, were recently opened by the Prince of Wales. The Treasurer stated that nearly $500,000 had already been received for the endowment fund of the hospital in answer to the appeal of the Prince of Wales.

WITH the concurrence of the Astronomer Royal, a site has been fixed in Greenwich Park for the new magnetic observatory.

IN a notice of Mr. J. B. Leiberg's report of his botanical survey of the Coeur d'Alene mountains, Idaho, in the summer of 1895 (Contrib. U. S. Natl. Herb., Vol. V., No. 1), in the current number of the *American Naturalist*, Dr. Bessey remarks: "It is interesting to note that, in spite of the fact that this report has a marked economic flavor, all measurements are metric throughout. Certainly if the United States Department of Agriculture can safely use the metric measurements in a bulletin dealing with topography, drainage, climate, mineral deposits, agricultural capacity, agricultural products, grazing lands, native food plants, utilization of water supply, forest resources, forest destruction, forest preservation, etc., botanists need no longer fear to make use of such measurements in their books, even of the most popular character."

INVESTIGATIONS by Tangl, of Budapest, which are reported on in *Pflüger's Archiv*, are of interest to those who have the management of horses. He finds that digestion proceeds more rapidly in the horse if eating is followed by active exercise than if it is followed by a period of rest. This is the opposite of what

takes place in the dog and in man, but the difference need not occasion surprise, in view of the difference in food and habits.

M. Moissan reported to the Paris Academy of Sciences on May 31st that, in conjunction with Professor Dewar, he had succeeded in liquefying fluorine.

We learn from *Nature* that the British Board of Agriculture has issued an order which prohibits the importation of dogs into Great Britain from any other country (except Ireland and the Isle of Man) otherwise than in accordance with certain provisions set forth. The order takes effect on September 15, 1897. After that date no dog may be landed in Great Britain from any other country without a license from the Board of Agriculture, application for which is to be made to the Secretary of the Board.

The maps of the Orinoco-Essequibo region of South America compiled for the use of the Venezuela Boundary Commission have been published in atlas form. There are seventy-six maps in all, of which fifteen are new and made especially for the Commission's use, while the remaining sixty-one are fac-simile reproductions of old ones selected from the large number brought to the attention of the Commission.

An Association of Teachers of Science in Indiana was organized in 1896, and held its second meeting at Lafayette on February 26th and 27th. We learn from the *Inland Educator* that a committee consisting of Professor D. W. Dennis, Richmond, Ind.; Professor Dumont Latz, South Bend, Ind.; Professor M. B. Thomas, Crawfordsville, Ind.; Professor J. T. Scovel, Terre Haute, Ind., and Professor G. A. Abbott, Evansville, Ind., was appointed by the Association to investigate the questions discussed and report a course of science study for the high schools of the State. The questions before the committee are: What subjects should constitute a science course? How much time should be given to each? In what order should they be considered? How much laboratory work should be required? etc. The committee would be glad to hear from every science teacher and interested school official in the State in regard to these and kindred questions.

Natural Science states that Mr. A. Gibb Maitland, late of the Geological Survey of Queensland, has been appointed Government Geologist of West Australia, and is reorganizing the staff with the view of making a proper geological survey of the mining fields of the colony and publishing maps of the same. As a preliminary to this a typographical survey is being prepared with the assistance of a topographer. Mr. Torrington Blatchford, of the Sydney School of Mines, who has had much practical experience of mining geology, has been added to the staff. Applications have also been invited by the government for the position of Assistant Geologist; while as Mineralogist and Assayer there has been appointed Mr. Simpson of the Sydney School of Mines, late Chief Assistant Assayer to the Mount Morgan Co., Queensland.

UNIVERSITY AND EDUCATIONAL NEWS.

Five additional fellowships have been established at the University of Pennsylvania on the Harrison Foundation. The University now offers nineteen fellowships of the annual value of $500 each and five senior fellowships of the value of $800.

The Lawrence Scientific School of Harvard University receives $5,000 by the will of the late Miss Edith Rotch, of Boston.

A memorial scholarship of the value of $8,000 has been given to Vassar College by Mrs. Ann Shepard, of Brooklyn.

Mr. H. A. Morgan, of the Board of Trustees of Wells College, has given the College $30,000, covering the debt on the rebuilding of the main building in 1890.

The Trustees of Syracuse University have contributed $32,000 to cover the deficit in current expenses, half of this amount being given by Mr. Jno. D. Archbold, President of the Board.

The naval authorities have decided to establish a post-graduate course at the Naval Academy for cadets intended for the construction corps, and orders have been issued directing Assistant Constructor Hobson to report for duty at the head of the department.

The catalogue of the University of Minnesota for the year 1896 shows that there was at the University an attendance of 2,647 students, of which number 728 were women. There were 156

students in the graduate departments, 909 in the College of Science, Literature and the Arts, and 181 in the College of Engineering, Metallurgy and the Mechanic Arts. 307 degrees were conferred at the commencement exercises on June 3d.

OF the £30,000 immediately required towards the endowment fund of the new Sheffield University College £24,000 has already been subscribed.

DR. A. HILL, Master of Downing College and lecturer on human anatomy, has been elected Vice-Chancellor of Cambridge University for the coming year.

AT Columbia University Mr Herbert M. Richards has been appointed tutor in botany; Dr. James Ewing, instructor in clinical microscopy; Dr. Charles Norris, tutor in pathology; Mr. Benjamin Jakish, assistant in chemistry; Mr. William E. Day, assistant in physics, and Mr. James H. McGregor, assistant in zoology.

AT the Teachers' College, New York, Mr. Richard E. Dodge has been promoted to a professorship of geography, and Mr. C. E. Bickle to an associate professorship of mathematics.

DR. CHARLES ST. JOHN, of the University of Michigan, has been made professor of physics at Oberlin College.

PROFESSOR WILLIAM A. ROGERS has resigned from the chair of physics and astronomy at Colby University, and it is reported that he has accepted a professorship of physics at Alfred University.

DISCUSSION AND CORRESPONDENCE.

THE DISTRIBUTION OF MARINE MAMMALS.

TO THE EDITOR OF SCIENCE: The interesting memoir of Dr. P. L. Sclater 'on the Distribution of Marine Mammals' (SCIENCE, V., 741–748) ignores previous investigators, and the general reader might, therefore, receive the idea that the subject under consideration has been entirely neglected by other writers, and would be also liable to suppose that his 'six sea-regions' were of equal value. In both postulates he would be entirely mistaken. The bearings of marine mammals on zoogeography and the differentiation of the 'regions' into primary and secondary ones have been frequently considered by others.

Dr. Sclater considers that, "for the geography of marine mammals, the ocean may be most conveniently divided into six sea-regions, which are as follows:"

'I. *Regio Arctatlantica.*'
'II. " *Mesatlantica.*'
'III. " *Indopelagica.*'
'IV. " *Arctirenica.*'
'V. " *Mesirenica.*'
'VI. " *Notopelagica.*'

The characteristic types of each of these regions are named, but Dr. Sclater has evidently overlooked some sources of information and hence has unduly restricted certain forms. Thus, the *Balæna mysticetus* is by no means 'peculiar to Arctatlantis,' but has been the object of an extensive fishery north of Bering strait.* Nor are *Delphinapterus* and *Monodon* 'not found elsewhere,' for they also occur in Arctirenia. Further, *Berardius* is not restricted to the Notopelagian area, for a species occurs in the North Pacific.† It follows that these extensions of the ranges of the several genera diminishes the value of the regions supposed to be distinguished by their exclusive possession. If we have regard for the most characteristic aggregates of sea mammals, we are led to three primary divisions, viz:

Arctalian realm.	I.	Regio	Arctalantica.
	IV.	"	Arctirenica.
Tropicalian realm.	II.	"	Mesatlantica.
	III.	"	Indopelagica.
	V.	"	Mesirenica.
Notalian realm.	VI.	"	Notopelagica.

The Arctalian realm is characteristic from the development of the Phocine Phocids, the Odobænids or 'Trichechidæ' and the Delphinapterine Delphinids. The North Atlantic and North Pacific 'sea-regions' are distinguished from each other by features of much inferior importance.

The Tropicalian realm is remarkable for the development of the existing Sirenians and likewise of numerous Delphinine Del-

*See Dall in SCIENCE (n. s.), V., 843, May 28, 1897.

†Berardius Bairdii Stejneger, Proc. U. S. Nat. Mus., VI., 75, 1883.

phinids, and it is also the home of Phocids more nearly related to the Phocines than the Lobodontines (though often associated with the later), but of a more generalized type than either and probably entitled to subfamily distinction—the Monachinæ. The subdivisions of this realm, so far as the marine cetaceans are concerned, are of very subordinate importance, and the restrictions of the Monachine seals and different families of Sirenians are the most noteworthy characteristics.

The Notalian realm is specialized by the development therein of a peculiar subfamily of seals—the Lobodontine Phocids.

These three realms were distinguished as early as 1875 and named in 1877.* They are well fitted for the expression of the facts of distribution of the marine mammals, but for those respecting other classes two transition realms appear to be advisable—the Pararctalian and Antarctalian, and doubtless two others—the Pelagalian and Bassalian—should also be recognized. If the last are adopted most of the cetaceans should rather be relegated to the Pelagalian realm. I venture to add the opinion that the realms thus advocated are much better comparable with Dr. Sclater's land-regions than are his own sea-regions.

THEO. GILL.

MR. T. L. SCLATER, in his very interesting paper, 'On the Distribution of Marine Mammals' (SCIENCE, May 14, 1897), makes the following remarks on the seals of the Galápagos (p. 742): "There are well founded traditions of eared seals having been formerly met with in the Galápagos, while they still occur on the coast of Peru and Chili."

Two species of seals are found on the Galápagos, as has been stated by J. A. Allen† in the extensive work on the North American Pinnipeds. *Otaria jubata* (Forster) and *Arctocephalus australis* (Zimmermann), of both specimens, have been collected by the Hassler expedition (1872), which are preserved in the Museum of Comparative Zoology, Cambridge, Mass.

Otaria jubata (Forster) is still quite common on the Galápagos. I have met it on Chatham, Charles, Hood, Gardner, Barrington, South Albemarle, Duncan, Jervis and James. They are found in considerable numbers, especially on Hood and Gardner, Barrington and Duncan. On the latter some of the rocks, where they move about, are polished absolutely smooth.

I have not seen any specimens of *Arctocephalus australis* (Zimmermann), but whether they are extinct or not I do not dare to say.

The presence of *Sphenicus mendiculus* (Sundevall), a penguin peculiar for the Galápagos is interesting.

The most extensive data on the seals of the Galápagos and the seals of the South Pacific and Antarctic Ocean are given by Benjamin Morrell (a narrative of four voyages to the South Sea and South Pacific Ocean, Indian and Antarctic Ocean from 1822 to 1831. 8°. New York, 1832).*

The seals have been mentioned already by the first discoverer of the Galápagos, Fray Tomás de Berlanga,† obispo (bishop) de Castilla del Oro, on the 10th of March, 1535. He had the order from the Emperor Charles V. to report on the government of Pizarro and to write a description of Peru. The 23d of February, 1535, he sailed from Panama. For seven days the wind was favorable, but after that a calm set in for eight days and the very strong currents drifted the vessel far out to the sea. The 10th of March they sighted an island and, having only water for two days more, they anchored to look for water and fodder for the horses. There they found nothing but seals, sea-turtles and land tortoises so big that each could bear a man on its back, and many iguanas, which are like snakes. ("No hallaron sino lobos marinos y tortugas y galápagos tan grandes, que llevable

*See SCIENCE (n. s.), III., 515, 1896.

†Allen, Joel Asaph: History of North American Pinnipeds; A Monograph of the Walruses, Sea-Lions, Sea-Bears and Seals of North America; U. S. Geolog. and Geogr. Surv. of the Territ.; F. V. Hayden, Geologist-in-Charge. Miscellaneous publications—No. 12, Washington, 1880, p. 208, 210–211, 367, 769–770.

*In 1823 he took in a period of two months about five thousand fur-seal skins (*Arctocephalus*) from the Galápagos.

† Marcos Jiménez de la Espada. Las Islas de los Galápagos y otras más poniente. Sociedat Geografica de Madrid. 1892. pp. 1–5.

cada uno un hombre encima, y muchas iguanas, que son como sierpes.")

G. BAUR.
UNIVERSITY OF CHICAGO.

THE article of Mr. Sclater in SCIENCE, May 14th, on the distribution of the Seals, Sirenians and Cetaceans, disregards the more recent publications on zoogeography, especially marine zoogeography. It begins with a somewhat indefinite statement, that 'most of the recent writers on Geographical Distribution have confined their attention to terrestrial mammals, or, at any rate, have but casually alluded to the marine groups of that class.' I may be allowed to state that the deficiency of our knowledge of the distribution of marine animals induced me, nearly two years ago, to publish a book,* which is particularly intended to supply this lack. It seems, however, that Mr. Sclater never has seen this book. Mr. Sclater seems also to be unacquainted with many other writings on the same subject, published since Wallace. I mention only the names of A. Agassiz, G. Baur, T. N. Gill, Guenther, v. Ihering, J. Murray, Neumayr, Pfeffer, J. Walther. The natural consequences of this neglect are most evident.

I do not think it worth while to enter into a closer examination of the theoretical views of Mr. Sclater, since all these points have been discussed by myself and others so extensively that anybody who has followed these discussions will see at once that his theoretical views are far from being in conformity with current theories. I shall state, however, a few points in the article referred to, by which it is proved conclusively that he did not consult most of the writers quoted above.

1. The term 'life-district' ('Lebensbezirk,' 'domaine biologique') seems to be completely unknown to Mr. Sclater; otherwise he would have treated the Cetaceans separately from the Seals and Sirenians. (Compare J. Walther, Ortmann, Chap. 3.)

2. The importance of the action of temperature-conditions has been completely overlooked by him; otherwise the effect of temperature should be shown in his sea-regions. (Compare Gill, Pfeffer, Ortmann, p. 37.)

3. The distinction of autochthonts, immigrants and relicts (compare Guenther, Ortmann, p. 34) is unknown to Mr. Sclater; otherwise he would have assigned a different value to the eared seals inhabiting the northern Pacific in comparison with the other seals; Phoca and Trichechus are autochthonts, while the Otariidæ are immigrants.

4. It is impossible to distinguish properly any distributional regions, which depend merely on a particular group of animals. The outcome will always be unsatisfactory. The regions created by Mr. Sclater are a striking evidence of the inconveniences of this method, as I have already pointed out in the beginning of Chap. 4 (p. 44–45) of my book. I mention only one instance: the fact that Trichechus and Phoca are found in the northern parts of both the Atlantic and Pacific Oceans is in no way represented in Mr. Sclater's division, although this fact is a very characteristic one, and, indeed, is the *rule* for the distribution of littoral polar animals. This rule is justified and supported by the physical conditions of the polar seas. Nevertheless, Mr. Sclater does not pay any attention to it, and frames his regions with regard to exceptional cases. (Compare eared seals, above, under 3.)

5. The definition of the Mid-Pacific Sea-region of Mr. Sclater is insufficient. In fact, he does not give any limits, nor any characteristics of this region.

6. The relations of his Indian Sea-region to his Mid-Atlantic Sea-region, due to the geological conditions of former times, and still exhibited in the distribution of the Sirenians, are not referred to at all, and of course no attempt has been made to explain them. (Compare Ortmann, p. 67 f.)

7. Mr. Sclater concludes that the distribution of the Otariidæ proves a connection of South America with Africa by land. I should suggest to him to read the papers of v. Ihering on this subject (Archhelenis), before he tries to bring the distribution of the eared seals in connection with this old continent. The old Archhelenis has positively nothing to do with the distribution of the sea lions; the latter are late Tertiary, while the Archhelenis was chiefly Mesozoic! The absence of any Otariidæ in the middle and northern Atlantic is exclusively due to temperature conditions.

*Grundzüge der marinen Tiergeographie, Jena, 1896.

8. In conclusion I should like to direct attention to the final statement of Mr. Sclater. Having made the (incorrect) supposition that the late-Tertiary group of the eared seals has been checked in its northward advance in the Atlantic by a connection of South America and Africa, he says that "all these facts, *with the one exception* of the supposed Atlantic barrier, would tend in favor of the *now generally accepted* doctrine that the principal masses of land and water are not of modern origin, but have existed mainly in their present shapes *throughout all ages.*" No less than three errors are contained in this single sentence, namely: 1. It is impossible to derive from the distribution of a group of Tertiary animals any conclusions as to the shapes of the principal continental masses *throughout all ages.* 2. This statement would hold for the Tertiary time only if we consider that the connection of South America and Africa, which is supposed by Mr. Sclater, is no important feature. Mr. Sclater admits that this Atlantic barrier forms an exception to the rule; but, I should say, such an exception throws the whole rule aside. 3. It may be that Mr. Sclater himself has accepted the 'doctrine' of the persistency of the continents, but I protest most vigorously against calling such a 'doctrine' *generally accepted.* A dogma (and this would be the proper name for it) that has been contradicted by students in zoogeography, such as Baur, Beddard, Neumayr, v. Ihering and others (and I should add, which is rejected by almost *all* geologists) cannot be regarded as 'generally accepted.'

The distribution of the Seals and Sirenians, it is true, has never been investigated from a scientific standpoint, but there are only a few distributional features which seem to be anomalous at first sight (Sirenia, Otariidæ), and even these may be explained readily. The Sirenia point to conditions existing in the beginning of the Tertiary period, and it is well known that this group existed in the Eocene epoch. The distribution of the Otariidæ is analogous to what has been called (improperly) 'bipolar' distribution. They represent the somewhat rare case of an Antarctic group of littoral animals which has crossed the tropics along the western coast of America and reached the northern Pacific. As to the latter fact I refer to a special paper published by me recently, which is especially devoted to this peculiarity of distribution.*

ARNOLD E. ORTMANN.

PRINCETON UNIVERSITY, June, 1897.

THE POTTER'S WHEEL IN AMERICA.

MY neglect to mention the *Kabal*, pointed out in Mr. Mercer's letter (SCIENCE, p. 919), was not an oversight, but for two reasons: First, as he mentions, because the word with that meaning does not occur in the Maya dictionaries of the sixteenth century; and secondly, because the *Kabal* is not a potter's wheel in its results or in a technical sense.

This is shown in Mr. Mercer's own work, 'Hill Caves of Yucatan,' p. 77, where he quotes Captain Maler as saying that he 'had found no trace of the potter's wheel in the old specimens of pottery,' anywhere in Yucatan. Mr. Mercer brought no potsherds from ancient deposits to contradict this; and according to his own words the *Kabal*, as used to-day, does not give 'the regularity of outline' which is the artistic aim of the potter's wheel. (P. 164, note.)

D. G. BRINTON.

SCIENTIFIC LITERATURE.

The Cambridge Natural History. Edited by S. F. HARMER, M.A., and A. E. SHIPLEY, M.A. Vol. II., Flatworms, etc. Macmillan & Co. 1896. 8vo. Pp. xii+560, 257 figs.

Volume II. of the Cambridge Natural History, the third of the series to make its appearance, deals with those classes which are usually grouped together as Worms or Vermes, and Polyzoa. The different classes are treated by specialists whose names are familiar in connection with the subjects assigned to them. The work is shared by seven authors, as follows: Platyhelminthes and Mesozoa, by F.W. Gamble, pp. 1–96, Figs. 1–47; Nemertinea, by Lilian Sheldon, pp. 97–120, Figs. 48–61; Nemathelminthes and Chætognatha, by Arthur E. Shipley, pp. 121–194, Figs. 62–105; Rotifera, Gastrotricha and Kinorhyncha, by Marcus Hartog, pp. 195–238, Figs. 106–120; Archiannelida, Polychæta and Myzostomaria, by W. Blaxland Benham, pp. 239–344, Figs. 121–186; Oligo-

* Zool. Jahrb. Syst., Vol. 9, 1896, pp. 571–595.

chæta and Hirudinea, by F. E. Beddard, pp. 345–408, Figs. 187–210; Gephyrea and Phoronis, by Arthur E. Shipley, pp. 409–462, Figs. 211–231; Polyzoa, by Sidney F. Harmer, pp. 463–533, Figs. 232–257.

Fifty pages of Mr. Gamble's account are devoted to the Turbellaria, twenty-three pages to Trematodes, eighteen to the Cestodes and five to the Mesozoa, the major part dealing with the groups in which the author is most at home. A detailed description is given of the structure and habits of a common Polyclad (*Leptoplana tremellaris*) and a common Triclad (*Planaria lactea*), together with a general account of the different groups. It is to be regretted that the same method was not followed with the Rhabdocœles, with Mesostoma as the type, a cosmopolitan form, which has, perhaps, been the object of study more than any other Turbellarian. The account, on the whole, is the best that we have for the Turbellaria. But a few slips and inaccuracies occur, chief among them being the statement that land planarians are 'cylindrical,' and that "freshwater planarians vary from a quarter to half an inch in length," whereas it is known that among the common European species, *Dendrocœlum lacteum* (*Pl. lactea* of the author) reaches a length of 26 mm. (Iijima), *D. punctatum*, 5 cm. (Hallez), and *Pl. gonocephala*, 25 mm. Again, the 'sucker' of *Pl. lactea* is said to have been 'discovered by Leydig' instead of v. Baer or Dugés. Among the Rhadocœles no mention is made of the fact that certain members of the genus *Mesostoma* are viviparous, and of the relation between this condition and the occurrence of the thin-shelled 'summer eggs.'

The chapters dealing with the Trematodes and Cestodes are comparatively meagre, but are an excellent epitome of our knowledge of the parasitic flatworms. Structural matters are scarcely touched upon, the account consisting chiefly of life-histories, the life-history tables being novel and instructive. *Distomum magnum* is said (p. 4.) to be parasitic in sheep (!).

The Nemerteans are dismissed by Miss Sheldon in twenty pages, a small space for so important a group, particularly in the light of the extensive recent researches. The classification adopted is that of Hubrecht, although the more rational one of Bürger is printed, with the excuse that this author's work appeared too late to be adequately considered. One paragraph devoted to 'palæontology' tells us that Nemerteans 'are unknown in a fossil state.'

Mr. Shipley's chapters on the Nemathelminthes and Chætognatha are valuable compilations of the natural history of these orders, and the recent researches on the problematic Acanthocephala are here brought together for the first time. Synoptic tables are given of the species of Chætognatha, and Conant's list of American species finds a place in an appendix at the end of the volume.

In Professor Hartog's account of the Rotifera and their allies the most striking thing is the author's declaration of the relationships of the Rotifera with the lower Platyhelminths and his comparison of them with the *Pilidium* of the Nemerteans, the older idea of arthropod affinities being abandoned. A pleasing feature is a brief description of the technique for the preservation of Rotifers.

The most extensive section in the book comprises Dr. Benham's chapters on the Archiannelida, Polychæta and Myzostomaria. Under the second of these classes the general account is prefaced by a detailed description of a typical Polychæte (*Nereis pelagica*), as in Mr. Gamble's account of the Turbellaria. The classification employed is a modification of that proposed by by the author in 1894, according to which the various families are grouped under two 'branches' and seven 'sub-orders.' Following a general account of the structure and biology comes a systematic portion in which the various sub-orders are illustrated by descriptions of British species.

Mr. Beddard's account of the Oligochæta offers nothing new of importance, the chapter being an excellent summary of the general part of the author's recent monograph, and a good sketch of a group to our knowledge of which he has contributed so much.

The same author's chapter on the Hirudinea is not so carefully done as that on the earthworms, and at times is careless and almost flippant in its treatment. *Inter alia* we learn such bits of natural history as that "the former extensive use of the leech has led to the trans-

fer of its name to the doctor who employs it," and that "it has been suggested, however, that the term was applied rather by way of analogy." Again, in reading of the intelligence of the land-leeches of Ceylon we learn that "they may ascend herbs and shrubs to gain a better outlook when they are aware of an approaching footstep." The most valuable part of Mr. Beddard's account of the Hirudinea is his discussion of their relationships with the Oligochæta.

The chapters of Mr. Shipley on the Gephyrea and Phoronis are among the best in the book, and his treatment of the affinities of these troublesome forms is most full and impartial. The account also includes a table of genera and species.

The excellent final chapter by Mr. Harmer on the Polyzoa is restricted to British forms, and concludes with a detailed table for the determination of British genera.

As a whole, the work is to be most highly commended and is the best general account of 'worms' that has appeared. If the scope of the book had been somewhat more extended so as to include, in all classes, other than British forms, its value and usefulness would have been much enhanced. In criticism it can be said that the book is not altogether well balanced as to the space alloted to the different classes, and that a general introduction on affinities and classification in addition to the tables which precede the text would have been of value for the student. The illustrations, with a few exceptions, are of the highest order and include many new ones; as exceptions may be mentioned Figs. 8 and 14, which are little more than caricatures.

W. McM. Woodworth.

The Swastika. By Thomas Wilson. Washington, Government Printing Office. 1896.

This extensive monograph of about 250 pages, with 25 full plates and 374 figures in the text, is from the report of the National Museum for 1896. The author is the Curator of the Department of Prehistoric Archæology in the Museum, and well known to students in that branch. His subject is the hooked cross, that figure called in English the 'fylfot' (four footed), and in the East Indies, *swastika*. This the author, in his sub-title and throughout his volume, claims as 'the earliest known symbol,' and prepares to point out its 'migrations.'

The subject is by no means a new one, as Mr. Wilson's appended bibliography abundantly shows; but there have been so many explanations of the origin and significance of this figure, and so many claims made for it as of historic value in indicating early migrations or relations of tribes, that it was quite desirable that a calm survey and clear analysis of them should be made. Mr. Wilson, by his wide reading and acquaintance with prehistoric archæology, is eminently qualified to accomplish this task; but by reason of his general theories on the origins of culture has, it must be said, failed in his presentation.

Not that his volume lacks in thoroughness, or that it is not of very high value to anyone who would trace the prevalence of this figure in both the Old and the New World. In these respects the work is satisfying; it overflows with quotations, and is accurate and attractive in its numerous illustrations. But all this wealth of resource is, in the opinion of many close students of the topic, seriously injured by two hypotheses of the author which continually interfere with the accuracy of his perspective.

These are, first, that the *swastika* is always to be regarded as a symbol; and, secondly, that it 'migrated' from one or two centers and was in some sense a racial or ethnic figure.

Both of these hypotheses have been shown to be unquestionably erroneous by the latest researches in the decorative art of both hemispheres. The 'fylfot' in American, Polynesian and Asiatic art has been proved by Von den Steinen, Stolpe, Regnault and others to be as purely decorative as it is in modern wall paper. It has been found in Semitic and Egyptian art, whence scholars of Mr. Wilson's school have tried to exclude it. Like other simple linear figures, its origin is not single but multiple; and both as a picture and a symbol it has stood for widely diverse objects. The mysteriousness which has been thrown about it disappears on an examination of its origins and meanings in many different tribes wide apart in geographic location; and had the author of the volume before us, so excellent in many respects, sur-

veyed his vast aggregation of facts in their purely objective relations, we are sure he also would have reached this conclusion.

D. G. BRINTON.

L' Origine de la Nation Française. By PROFESSOR GABRIEL DE MORTILLET. Paris, Felix Alcan. 1 vol. Pp. 336. With 18 maps and 158 illustrations. Price 6 francs.

In this work Professor Mortillet means to begin at the beginning, so that he passes as merely modern the classical writers and even the dispersion of the Aryans, commencing his history of the French people about 230,000 years ago, and not willingly admitting any fundamental alteration since in the racial type.

His volume is divided into several parts, the first embracing a review of what the Greek and Roman writers said about the area he is discussing. He recognizes the Ligurians as a distinct people, representing, probably, what might be called the autochthonous type. On the other hand, he believes that Gauls, Celts and Germans were a single and exotic type, one that at various remote as well as modern dates invaded the soil of France and made much noise in history, without profoundly affecting the primitive inhabitants.

His chapter on the languages is the least satisfactory of the book. He does not present accurately or even fairly the principles or the results of the best school of linguistic ethnology. His treatment of the Aryan question—one all-important in the prehistory of Europe—is quite inadequate, and is chiefly occupied with the opinions of authors now antiquated (Pictet, etc.).

A chapter on the ancient forms of writing and alphabets which have been discovered in France is abundantly illustrated and full of interest. His conclusion is that neither history, language nor etymology can solve the problem of the origin of the French peoples, so he turns toward prehistoric discoveries.

These occupy the latter half of his work. Here the author is thoroughly at home with his subject. He explains in clear and forcible language the doctrine of the development and transformation of organic forms up to the semi-human *Pithecanthropus*, and finally, to man, in in the early Quaternary. This remote ancestor is traced on the soil of France through his oldest 'Neanderthaloid' condition, when all his tools were of rough stone and his skin still hairy, down to a date when he was rudely assaulted by some people of higher culture arriving from the distant East, bringing with them more murderous weapons of polished stones and the far-killing bow and arrow. These were Neolithic tribes, brachycephali, from somewhere between Thibet and Asia Minor. They were followed in later days by another Asian invasion, from a remoter point of the Orient, who introduced bronze and the knowledge of tin.

From the commingling of these various streams on the soil of France, Professor de Mortillet would derive the present French nation, allowing, in addition, the known historic alliances. His principal point is, that from remotest antiquity, unerased by boreal glaciers or Roman swordsmen, by Semitic pirates or Allemanian war-lords, there has lived in the fertile valleys and on the green mountain sides of France the same 'patient, industrious democracy,' which, by its tenacious energy and unflagging labor has placed their nation as the leader in the van of modern civilization.

There is much in these theories of prehistoric migration in conflict with prevailing opinion in France itself—much that the author fails to support by convincing arguments. But apart from all questions of opinion, no reader can be disappointed in the remarkable amount of accurate information gathered in his pages and presented in a bright, pleasing style, which will render the volume attractive even to those who are but incidentally interested in the problems it undertakes to solve.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, JUNE.

The Constituents of Pennsylvania, Ohio and Canadian Petroleum between 150° and 220°: By C. F. MABERY. The author refers to the conflicting statements published with regard to the composition of Pennsylvania petroleum based partly on the results of investigations on the Rus-

sian oil and partly on the results of Warren's and Pelonge's and Cahours' investigations of Pennsylvania petroleum. He shows that Pelonge's and Cahours' distillations were not carried far enough to obtain individual products and that, while Warren's separations were very thorough, his methods of purification were very crude and insufficient. In the work here described two principal objects were kept in view: the one to determine the series of hydrocarbons which form the main body of American petroleum, and the other to ascertain whether the composition of Pennsylvania, Ohio and Canadian oils, as regards their principal constituents, is the same. The author concludes from the results of a very thorough and exhaustive study that the constituents of Pennsylvania petroleum with boiling-points at 163°–164°, 173°–174°, 196°–197°, and at 215°–216°, are decanes and constitute the main body of the petroleum within these limits, and that whatever other bodies may be present are to be found only in small quantities. In order to obtain these products not only was prolonged distillation resorted to, but the products were treated with strong acids and sodium. In the Ohio petroleum the same products were obtained; but the amount of aromatic hydrocarbons is greater here than in the Pennsylvania oil. In the Canadian oil the products were the same as the others up to 173°. Products boiling at 196° and 214° were shown to belong to the series C_nH_{2n} and not, as the lower members do, to the series C_nH_{2n+2}. Although sulphuric acid is used on the large scale in refining oils, no definite information has ever been obtained as to its chemical action in these cases; but the author suggests some possible explanations. The author and Mr. E. J. Hudson have studied the refractive power of these products and find that the refractive power varies, as the specific gravity does, with the purity of the distillate.

On the Molecular Rearrangement of the Oximes by Means of Certain Metallic Salts: By W. T. Comstock. The author has found that not only does phosphorus pentachloride, strong sulphuric acid and several other reagents effect the Beckmann rearrangement of an oxime into an amide, but that several metallic salts are capable of producing the same results. He has found that cuprous chloride and bromide and antimony trichloride effect this reaction with the greatest ease. An intermediate cuprous chloride addition product is obtained in most cases, but this easily breaks down when the benzene solution is heated and forms the amide.

The Action of Urea and Primary Amines on Maleïc Anhydride: By F. L. Dunlap and I. K. Phelps. The authors have continued their experiments on a method described by them for obtaining imides by the action of urea on the anhydrides of dibasic acids. The intermediate addition product, which is an acid, was obtained in some cases, and attempts were made to prepare the imide of maleïc acid by this method. The intermediate product, maleüric acid, was easily obtained, but all attempts to obtain an imide in quantity sufficient for an examination failed. Several products were obtained by the action of primary amines on maleïc anhydride.

On the Isomeric Chlorides of p-Nitro-o-Sulphobenzoic Acid: By Ira Remsen and G. W. Gray. The formation of two chlorides of orthosulphobenzoic acid suggested experiments with substituted acids to see if isomeric chlorides could be obtained from these also. The authors have obtained the two chlorides from the p-nitro substituted acid in well characterized form, and have studied the transformations which take place under the influence of various reagents. Both give the same product with water; but when treated with ammonia the symmetrical compound forms the ammonium salt of the corresponding sulphinide, while the unsymmetrical compound gives the ammonium salt of the corresponding cyansulphonic acid. The structure of the two chlorides is best represented by the following formula:

$$C_6H_3(NO_2)<\begin{matrix}COCl\\SO_2Cl\end{matrix} \text{ and } C_6H_3(NO_2)<\begin{matrix}CCl_2\\SO_2\end{matrix}>O.$$

A number of salts of the sulphinide and sulphonic acid were made and studied, as well as the chloride and amide of the acid.

A Study of Ferric Hydroxide in Precipitation: By V. J. Hall. It is well known that many precipitates have the power to carry down other substances with them, and this is generally explained as an act of mechanical inclusion. Results obtained in a study of the action of potas-

sium hydroxide on aluminum sulphate have, however, led to the conclusion that the act is not entirely a mechanical one, but that it is a phenomena of strictly chemical nature. In the present paper the author has undertaken a study of the action in the case of iron hydroxide. While the results are not sufficient to definitely establish the nature of the action, they are inconsistent with the theory of mechanical inclusion and characteristic of chemical action. Reviews of the following books are also contained in this number of the journal:

'The Constants of Nature,' F. W. Clarke, Part V.; 'The Chemistry of Dairying,' N. Snyder; 'Inorganic Chemical Preparations,' F. H. Thorp; 'Traité Elementaire de Chimie,' Haller et Muller; 'The Principles and Practice of Agricultural Analysis,' H. W. Wiley, Vols. I., II. and III.; 'Vorlesungen über Bildung und Spaltung von Doppelsalzen,' J. H. Van't Hoff; 'An Outline of the Theory of Solutions and Its Results,' J. L. R. Morgan.

J. ELLIOTT GILPIN.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 278TH MEETING, SATURDAY, MAY 22.

DR. ERWIN F. SMITH described 'A Bacterial Disease of Cruciferous Plants,' illustrating his remarks by means of drawings, diseased plants, and cultures of the organism on various media. The parasite is a yellow germ and is considered identical with that isolated by Professor L. H. Pammel from rotting turnips. Nearly all of Pammel's statements are confirmed, and much new information has been obtained concerning pathogenesis, symptomatology, host plants, manner of infection, thermal relations of the organism and its behavior in a variety of media. The organism was isolated from Maryland turnips and Wisconsin cabbages and a parallel series of cultures and experiments instituted. The following plants have been artifically infected: Cabbage, kale, cauliflower turnip, rape, black mustard, and radish. The dissemination of the disease is probably due in great measure to insects. It has been transmitted in the greenhouse from diseased to healthy plants by means of slugs (*Agriolimax agrestis*) and also by means of the common cabbage worm (larvæ of *Plusia brassicæ*). The organisms show a marked preference for the vascular system of the plants, and a blackening of the veins of the leaves and of the vascular bundles of the stem is a prominent symptom. The vessels become crowded so full of the germs that they may be said to be plugged solid. The interior of the turnip rots, and the cabbage loses many leaves and fails to produce any head. The disease is widespread and well known to market gardners. The organism is rod-shaped, motile, ærobic; it does not produce gas or acid; it liquefies gelatin; it grows rapidly at room temperature (20° to 26° C.), especially on potato. It grows feebly at blood heat, and will not grow in the thermostat at 40° C. The thermal death point is approximately 51° C. It produces a brown pigment when grown on slices of turnip, but not when cultivated on potato or in beef broth.

Dr. B. T. Galloway spoke on 'the Effects of Environment on Host and Parasite in certain Diseases of Plants.'

It was stated that plants in their growth and development are controlled by two sets of factors, namely, inherited disposition acting from within and external influences acting from without. Around these factors are centered many complicated phenomena, and the object of the paper was to call attention to some of these in their relation to certain physiological and pathological problems. The statements in the main refer to cultivated plants, for in dealing with them in questions, such as those under consideration, conclusions could not be drawn from the behavior of wild species, except in the most general way. In other words, one of the fundamental tenets of agricultural and horticultural practices is that the occurrence and behavior of native plants in any given region is not in itself sufficient evidence to prove that cultivated forms may be successfully grown there. Purely local conditions may make the difference bebetween success and failure in growing the crop, and the effects of these conditions must be determined by observations and experiments on the plant itself.

The effects of environment on the host and the possible changes in the life processes as a

result of changed conditions were pointed out. The effects of the same conditions on the parasite were also considered. Finally attention was called to the cumulative effects of the attacks of parasitic fungi and other organisms. It was shown in certain cases that when plants are attacked by fungi there is a temporary expenditure of vital energy, and as a result metabolic processes are brought about which may put the host in a more receptive condition for further attacks. The following case was cited: "A disease of a greenhouse plant is in a specific case due to the attacks of a fungus which kills the leaf in distinct spots. These spots are frequently so numerous as to entirely destroy the plant. The disease develops naturally under certain rare conditions in the greenhouse. These conditions, however, can be produced artificially in the case of individual plants, and in such instances the spores of the fungus, which are always present in the house, will infect and in a short time produce the characteristic injuries. Now, by following this method for several months and causing the new leaves to become infected as they appear, the plant eventually gets into a condition when it can no longer resist the fungus. If the leaves are all cut off at this time the new leaves will be attacked as fast as they appear, without taking any precautions to surround the plant with conditions that will make it susceptible. The cumulative effects of the fungus, in other words, has probably resulted in bringing about the metabolic changes that at the outset had to be brought on by conditions of light, heat and moisture."

Mr. V. K. Chesnut presented a paper entitled 'The Poison of the Black Nightshade (*Solanum nigrum*. L.),' being a brief account of solanine. This glucoside-like alkaloid, although not a remarkably poisonous substance, is the active constituent of the plant. It is present in the leaf and berry, but in varying amounts according to conditions of growth. It is greatest in heavy-scented plants, but in some the amount is so small that the berry is edible, and has even an attractive taste. Severe cases of poisoning have, however, attended the use of the plant; so it can not be recommended as a food. The variation in chemical composition was attributed to the cosmopolitan nature of the plant which enables it to thrive well in different environments. Attention was called to the fact that the berries of *Solanum triflorum*, a native of the Great Plains region, was poisoning cattle in Nebraska.

F. A. Lucas,
Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

A General Meeting was held April 21st, fifty-nine persons present.

Mr. Herbert Lyon Jones spoke of the biological adaptations of our seashore plants, and defined the physiological differences between them and our ordinary plants. The classes and characteristics of seashore plants were mentioned, the vertical position of the leaves and the reduction of leaf surface noted.

The danger of too great a quantity of salt in the tissues of seashore plants is reduced by changes which reduce transpiration of water; adaptations follow the needs of plants; the fruit is especially adapted to withstand the effects of water. The differences and similarities between the plants of the seashore and desert plants were pointed out and illustrated by a series of lantern slides.

Samuel Henshaw,
Secretary.

NEW BOOKS.

The Chances of Death and other Studies in Evolution. Karl Pearson. London and New York, Edward Arnold. 1897. Vol. I., pp. xi + 388. Vol. II., pp. 460. $8.00.

Contribution towards a Monograph of the Laboulbeniaceæ. Roland Thaxter. Cambridge University Press, John Wilson & Son. Pp. 398. 26 Plates.

Sight. Joseph Le Conte. New York, D. Appleton & Co. 1897. Pp. xvi + 312. $1.50.

An Essay on the Foundations of Geometry. Bertram A. W. Russell. Cambridge University Press. 1897. Pp. xvi + 201.

The Induction Coil in Practical Work. Lewis Wright. London and New York, The Macmillan Co. 1897. Pp. viii + 172.